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Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978

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16. ABSTRACT

This report presents the costs associated with the construction of publicy owned wastewater treatment facilities. These costs are all derived from the actual winning bid documents for treatment plants eligible to receive monies from the Construction Grants Program of the Environmental Protection Agency EPA. Only plants funded under the Federal Water Pollution Control Act (PL 92-500) and its amended version. (PL 95-217), are a part of the data base. All data were obtained from the Construction Grants files at the ten EPA Regional offices.

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1.0 INTRODUCTION

This report presents the costs associated with the construction of publicly owned wastewater treatment facilities. These costs are all derived from the actual winning bid documents for treatment plants eligible to receive monies from the Construction Grants Program of the Environmental Protection Agency (EPA). Only plants funded under the Federal Water Pollution Control Act (PL 92-500) and its amended version, (PL 95-217), are a part of the data base. All data were obtained from the Construction Grants files at the ten EPA Regional offices.

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The data base used in this report makes use of as much of the MCD-37 data as is consistent with the analysis techniques. A large quantity of new data, collected during 1978 and 1979, has been added to the base and is reported herein. A total of 737 individual projects are now part of the files analyzed. These include projects involving 469 secondary treatment plants, 111 advanced secondary treatment (AST) plants, and 157 advanced wastewater treatment (AWT) plants. These can be further differentiated as 353 new construction, 48 enlargements, 55 upgrades, 267 enlargement and upgrades, five replacements, and nine as other projects.

These 737 projects represent approximately 5.8 billion dollars of grant eligible treatment plant construction expenditures adjusted to fourth quarter 1978 dollars. It is estimated this represents 4.3 billion dollars of Federal grant funds. Considering inflation and other factors, the data used in this study account for over one-half of the treatment projects which have gone to the construction stage (Step III) since the inception of the program.

This study, therefore, is certainly the most complete empirical analysis of construction costs developed to date for municipally owned wastewater treatment plants. It can be used, applying engineering judgment, for preliminary estimation of construction costs for individual processes and/or complete facilities. The reader is cautioned, however, that this report and the costs shown should not be used as a substitute for normal engineering estimating procedures. The results herein are statistical averages for the nation and do not necessarily reflect the site specific conditions which can drastically change the final costs. Local labor and material costs have been normalized.

This report discusses the method used to collect and analyze the data, after which the results are presented. Descriptions of how to use the cost curves, along with examples, are part of the main body of this report. Procedures to estimate costs for future years and to translate them to various sections of the country are presented. Kansas City, Missouri and St. Joseph, Missouri were chosen as the locations to which all costs were normalized. A section is also presented detailing a simplified method to estimate costs. The latter was developed for EPA for use in the 1980 Needs Survey.

The Appendix lists all the treatment plant construction projects used in the data base; a summary table, by state, of the size and types of projects used; and an explanation of the cost indexing procedures utilized.

Construction costs have been analyzed and reported by three levels of detail. The most general, called First Order costs, is for complete treatment plants of various types. All construction costs are included. The second level of detail, the Second Order costs, is for specific unit processes, such as clarifiers, chlorination, etc. The last level, the Third Order costs, is for the costs of various components required: excavation, electrical, instrumentation, etc.

As would be expected, bidding procedures and available documents vary considerably by location and size and type of project. Unit process and/or component costs are often not itemized on the bid documents, but were collected when they were available or could be deduced from the grant files. The data were analyzed for all types of plants, processes, and components which were collected. However, if the statistical analysis indicated the resulting curves were not reliable within a predetermined level, they were not reported herein.

The data collection effort is continuing as this report is being published. An additional 400-600 projects will be added to the data file during the next 18 months and an updated report will be published. All cost data will be updated. Additional unit processes and component costs should be available as the data base becomes larger.

Readers are encouraged to replace their copies of MCD-37, referenced above. Since this report contains virtually the same data base plus fifty percent more facilities, EPA feels the added information has significantly added to the statistical significance of the results. In addition, some new and different analysis techniques were utilized to develop the results presented. An increased accuracy is evident in this report when compared to its predecessor.

2.0 COST INFORMATION COLLECTION AND ANALYSIS TECHNIQUES

DATA COLLECTION

Project cost data from wastewater treatment plant construction projects were collected in all ten Regional offices of EPA. All data were taken directly from the project files of active Step III construction projects. The newly acquired data are from projects which included wastewater treatment plants for which competitive bids were received after January 1, 1977. All information was collected on specially designed forms using a coding system where necessary.

Following a quality assurance check, the data were keypunched and entered into an ADP file. The format of the data base used in the original MCD-37 report was made to conform with the new data, after which the two were merged. All discrepancies in format and logic were eliminated.

COST UPDATING AND DATA ANALYSIS

The first step in the analysis updated all cost information to fourth quarter of 1978 dollars. Step III cost data were updated from the calendar quarter in which the projects were actually bid, and Step I and Step II costs were updated from the date in which the respective grants were awarded. A more complete description of the updating process is presented in Appendix A.

Data analyses were conducted for construction and associated costs of wastewater treatment plants in order to provide the following levels of cost information:

1. Nonconstruction Costs - Total Step III nonconstruction costs, as well as Step I and Step II planning and engineering costs.

2. First Order - Total plant construction costs.

3. Second Order - Unit process construction costs and total plant construction component costs.

4. Third Order - Unit process component costs.

NOTE: Nonconstruction costs were not included in the First, Second, or Third Order relationships, but were analyzed separately as discussed in Section 3.0. They are to be added to the other costs as a separate item.

Linear regression relationships of design flow versus cost, and other parameters, in a few cases, were determined for each of the above levels of construction cost data. A computerized statistics package (The BMD Biomedical Computer Program developed by the University of California, Los Angeles) was utilized to determine the significance of the relationships and to plot the resulting linear regression equations.

Only those relationships with a sample correlation coefficient ≥ 0.70 are presented in this report. The sample correlation coefficient r is an indicator of the degree of linearity of the relationship between two variables. This may vary from zero (no relationship between the variables) to ± 1 (completely linear relationship). Furthermore, the value $r^2 \times 100\%$ indicates the amount of the variation in the dependent variable y which may be accounted for by differences in the independent variable x. Thus, an r value of 0.70 for a cost curve in this report would indicate that a 49 percent variation in cost is accounted for by differences in flow. Values of r for all First Order and Second Order plots are included on each plot.

The F-test values, which are also presented, may be useful in evaluating these relationships. The F-value can be compared with standard tables to test the hypothesis that the sample correlation coefficient versus zero against the alternative that the equation as a whole defines a significant relationship between the two variables - in this case, design flow versus cost. The F-value is the ratio of the mean square due to regression to the deviation's mean square as follows:

$$\text{F-value} = \frac{SSFE/K}{RSS/(N-K-1)}$$

The ratio is compared to the corresponding value from an F-table with K and (N-K-1) degrees of freedom, where N is the total number of points, K is the degree of freedom due to regression, and N-K-1 is the degree of freedom due to deviations. SSFE means sum of squares due to fitted equation; RSS means residual sum of squares.

DESCRIPTION OF THE DATA BASE

As noted in the Introduction, there are 737 wastewater treatment plants in the data base utilized for this report. It was also pointed out that 353 projects were construction of entirely new plants, 48 projects were enlargements of existing facilities, 55 projects were upgrading existing facilities, 267 were enlarging and upgrading of existing facilities, five were replacing projects, and nine were classified as "other." Enlargement is defined as increasing the design flow capacity of a facility of the same level of treatment. Upgrading is defined as an increase in the design treatment efficiency of a facility at the same flow capacity.

Table 2.1 presents a distribution of the projects used in this report by projected flow and level of treatment. Although there was no attempt to acquire a statistically valid sample of the total population of construction grants, the data is believed to reflect the trends of the program. It can be seen from Table 2.1 that 568 of the projects, or 77 percent of the total, were for plants of 5.0 mgd or less. Additionally, 469 projects, or 64 percent of the total, involved secondary treatment plants. Approximately 52 percent of these secondary plants were 5.0 mgd or less.

Table 2.2 summarizes the projects by type of secondary wastewater treatment process employed. It can be seen that 347, or 47 percent of the projects, were activated sludge facilities. Also 209 projects, or 28 percent, involved other types of processes. It should be noted, however, that "other" includes unit processes not listed on the table, as well as combinations of any of the listed unit processes.

TABLE 2.1

DISTRIBUTION OF WASTEWATER TREATMENT PLANT PROJECTS BY PROJECTED FLOW AND LEVEL OF TREATMENT

	< 1.00 MGD Projected Level of Treatment*					1.00-5.00 MGD Projected Level of Treatment*					5.01-25.00 MGD Projected Level of Treatment*					> 25.00 MGD Projected Level of Treatment*					
	A	B	C	D	Total	A	B	C	D	Total	A	B	C	D	Total	A	B	C	D	Total	Total
Alabama	0	3	0	0	3	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	6
Alaska	0	3	0	0	3	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	5
Arizona	0	6	2	0	8	0	3	0	0	3	0	2	0	1	3	0	0	0	0	0	14
Arkansas	1	1	2	1	5	0	1	3	0	4	0	1	1	1	3	0	0	0	0	0	12
California	0	11	1	0	12	0	9	2	1	12	0	7	1	6	14	0	5	1	5	11	49
Colorado	0	3	0	1	4	0	3	0	3	6	0	2	1	0	3	0	0	0	0	0	13
Connecticut	0	1	0	0	1	0	1	0	0	1	0	2	0	0	2	0	0	0	0	0	4
Delaware	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Florida	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	0	1	1	0	2	5
Georgia	0	3	1	0	4	0	1	3	4	8	0	1	1	0	2	0	0	0	0	0	14
Hawaii	0	2	0	0	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	3
Idaho	1	4	0	0	5	0	2	1	0	3	0	1	0	0	1	0	0	0	0	0	9
Illinois	0	7	1	10	18	0	2	4	11	17	0	2	2	6	10	0	0	0	1	1	46
Indiana	0	8	1	18	27	0	2	1	5	8	0	2	2	0	4	0	0	0	1	1	40
Iowa	0	7	2	1	10	0	4	1	1	6	0	1	0	1	2	0	1	0	0	1	19
Kansas	2	9	0	0	11	0	3	0	0	3	0	1	0	0	1	0	0	0	0	0	15
Kentucky	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Louisiana	0	6	0	0	6	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	9
Maine	0	1	0	0	1	0	2	0	0	2	0	1	0	0	1	0	0	0	0	0	4
Maryland	0	7	0	2	9	0	3	2	0	5	0	1	0	0	1	0	0	0	0	0	15
Massachusetts	0	2	0	0	2	0	2	0	0	2	0	3	0	0	3	0	1	0	0	1	8
Michigan	3	4	0	1	8	0	8	1	1	10	0	1	0	1	2	0	0	0	2	2	22
Minnesota	1	7	0	2	10	0	4	0	2	6	0	1	0	0	1	0	3	0	0	3	20
Mississippi	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	2
Missouri	0	11	0	0	11	0	4	1	0	5	0	3	0	0	3	0	1	0	0	1	20
Montana	1	1	0	0	2	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	4
Nebraska	0	11	0	0	11	0	4	0	0	4	0	2	1	0	3	0	0	0	0	0	18
Nevada	6	1	0	0	7	0	2	0	0	2	0	0	0	0	0	0	0	1	0	1	10
New Hampshire	0	2	0	0	2	0	3	0	0	3	0	0	0	0	0	0	1	0	0	1	6
New Jersey	0	0	0	0	0	0	3	0	0	3	0	6	0	1	7	0	4	0	0	4	14
New Mexico	0	1	0	0	1	0	2	2	0	4	0	1	0	0	1	0	0	0	0	0	6
New York	0	14	1	2	17	0	6	1	4	11	0	3	0	0	3	0	2	0	0	2	33
North Carolina	0	0	0	0	0	0	3	1	3	7	0	0	2	2	4	0	0	0	1	1	12
North Dakota	0	22	0	0	22	0	2	0	0	2	0	1	0	0	1	0	0	0	0	0	25
Ohio	0	8	3	4	15	0	4	3	3	10	0	2	3	4	9	0	2	0	2	4	38
Oklahoma	2	3	2	0	7	0	1	3	1	5	0	0	1	0	1	0	1	0	0	1	14
Oregon	0	5	4	5	14	0	1	0	2	3	0	0	2	2	4	0	1	0	0	1	22
Pennsylvania	0	14	6	2	22	0	11	6	2	19	0	2	1	3	6	0	1	0	1	2	49
Rhode Island	0	2	0	0	2	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	4
South Carolina	0	0	1	0	1	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	3
South Dakota	6	1	0	0	7	0	3	0	1	4	0	0	0	0	0	0	0	0	0	0	11
Tennessee	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	1	0	1	2	4
Texas	0	1	6	0	7	0	3	5	0	8	0	0	2	3	5	0	0	0	2	2	22
Utah	3	1	0	2	6	0	0	0	2	2	0	1	1	1	3	0	0	0	0	0	11
Vermont	0	6	0	0	6	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	7
Virginia	0	5	0	1	6	0	4	1	0	5	0	2	0	2	4	0	2	0	2	4	19
Washington	1	7	0	1	9	0	9	0	0	9	0	1	0	0	1	0	1	0	0	1	20
West Virginia	0	1	0	0	1	0	3	1	0	4	0	0	0	0	0	0	0	0	0	0	5
Wisconsin	1	6	3	0	10	0	4	1	2	7	0	2	0	0	2	0	2	0	0	2	21
Wyoming	1	1	0	0	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	3
TOTALS	29	219	37	55	340	0	132	48	48	228	0	59	23	36	118	0	30	3	18	51	737

* Levels of Treatment:
A - Less Than Secondary Treatment and No Discharge
B - Secondary Treatment
C - Advanced Secondary Treatment
D - Advanced Wastewater Treatment

TABLE 2.2

DISTRIBUTION OF WASTEWATER TREATMENT PLANT PROJECTS BY TREATMENT PROCESS

	Activated Sludge	Trickling Filter	Stabilization Ponds	Aerated Lagoons	Rotating Biological Contactor	Other	Totals
Alabama	4	0	1	0	0	1	6
Alaska	2	1	0	0	0	2	5
Arizona	5	0	1	1	0	7	14
Arkansas	6	1	1	0	0	4	12
California	15	6	2	3	0	23	49
Colorado	7	0	0	0	0	6	13
Connecticut	2	1	0	0	0	[illegible]	4
Delaware	2	0	0	0	0	[illegible]	2
Florida	2	1	0	0	0	[illegible]	5
Georgia	7	2	1	0	0	[illegible]	14
Hawaii	1	0	0	0	0	2	3
Idaho	5	0	2	1	0	1	9
Illinois	18	2	1	0	1	24	46
Indiana	22	0	1	1	2	14	40
Iowa	3	1	3	1	4	7	19
Kansas	6	1	5	0	0	3	15
Kentucky	0	0	0	0	0	0	0
Louisiana	7	0	0	1	0	1	9
Maine	3	0	0	0	1	0	4
Maryland	14	0	1	0	0	0	15
Massachusetts	7	0	0	0	0	1	8
Michigan	8	1	2	2	4	5	22
Minnesota	7	1	4	0	0	8	20
Mississippi	2	0	0	0	0	0	2
Missouri	13	2	1	0	0	4	20
Montana	1	0	1	0	0	2	4
Nebraska	7	0	4	0	1	6	18
Nevada	0	2	2	2	0	4	10
New Hampshire	5	0	1	0	0	0	6
New Jersey	9	0	0	0	0	5	14
New Mexico	4	1	0	0	0	1	6
New York	23	1	0	3	0	6	33
North Carolina	3	2	0	0	0	7	12
North Dakota	0	0	20	1	0	4	25
Ohio	21	2	3	1	3	8	38
Oklahoma	5	1	4	0	0	4	14
Oregon	8	2	5	0	0	7	22
Pennsylvania	32	7	0	2	0	8	49
Rhode Island	4	0	0	0	0	0	4
South Carolina	2	0	0	0	0	1	3
South Dakota	2	0	7	0	1	1	11
Tennessee	4	0	0	0	0	0	4
Texas	15	4	0	0	0	3	22
Utah	3	1	5	1	0	1	11
Vermont	3	0	0	3	0	1	7
Virginia	10	2	0	1	0	6	19
Washington	6	0	5	2	0	7	20
West Virginia	1	1	0	0	1	2	5
Wisconsin	10	1	0	3	2	5	21
Wyoming	1	0	2	0	0	0	3
TOTALS	347	47	85	29	20	209	737

3.0 RESULTS OF THE DATA ANALYSIS

The results of all statistically valid relationships discernible from the existing data base are presented in this section. Nonconstruction costs are presented first since these costs are associated with all projects and all orders of cost equations presented. First, Second, and Third Order cost information follows. Examples of the use of these curves follow at the end of each section.

NONCONSTRUCTION COSTS

Nonconstruction costs include grant eligible Step I and Step II planning costs, as well as the nonconstruction costs associated with the Step III construction effort: administration, architect/engineer fees, contingency allowances, etc. These costs were nearly always discernible from the EPA grant files.

Table 3.1 presents the average ratios of all Step III nonconstruction cost categories to total construction costs for new construction projects. Total construction costs are defined as the grant eligible construction costs for the Step III portion of the project, excluding nonconstruction items. In most cases total construction costs are those directly related to the bid documents as submitted by the contractor(s). In addition to these costs must be added the nonconstruction categories listed in Table 3.1. Fifteen categories of nonconstruction costs are identified in this table. It should be noted that only five of these nonconstruction cost categories were found in the majority of the projects: administrative/legal costs, architect/engineering basic fees, other architect/engineering fees, project inspection costs, and contingencies. These five categories equal approximately 20 percent of the construction costs as a national average. The other ten categories of nonconstruction costs listed in the table can be a part of any particular project, yet they must be considered atypical as can be seen by their small sample size as compared to the five prime characteristics.

The total project costs for facilities constructed using EPA Construction Grant funds are a total of the construction costs, the Step III nonconstruction costs outlined above, and the Step I and Step II costs (preliminary and detailed design). Step I and II costs were analyzed for all projects having Steps I, II, and III grants. These were calculated as a fraction of the total construction cost (TCC) and are presented at the bottom of Table 3.1. They are 2.33 and 5.55 percent for Steps I and II, respectively.

A few projects also had significant ineligible costs. These are also presented in Table 3.1. Although present in only a few projects, these costs tended to be a significant percentage of the total construction costs when they were present - 10.8 percent on a national average, and as high as 26.2 percent in Region VIII.

TABLE 3.1

AVERAGE NONCONSTRUCTION COST RATIOS FOR WASTEWATER TREATMENT PLANTS

NEW CONSTRUCTION
NONCONSTRUCTION COST/TOTAL CONSTRUCTION COSTS

STEP III NONCONSTRUCTION & COST CATEGORY	REG. 01	REG. 02	REG. 03	REG. 04	REG. 05	REG. 06	REG. 07	REG. 08	REG. 09	REG. 10	NATIONAL	SAMPLE SIZE
Administration/Legal	.0119	.0167	.0201	.0068	.0088	.0092	.0071	.0127	.0094	.0112	.0117	320
Preliminary	.0316	.0101	---	---	.0116	---	.0053	.0106	.0072	.0141	.0120	25
Land, Structures, Right-of-Way	.0144	.0296	.0193	.0186	.0364	.2851	.0760	.1115	.0370	.0338	.0442	83
A/E Basic Fees	.1128	.0652	.1135	.0571	.0759	.0481	.0423	.0757	.0925	.0412	.0739	300
Other A/E Fees	.0342	.0509	.0112	.0236	.0386	.0166	.0156	.0252	.0286	.0258	.0287	178
Inspection	.0516	.0614	.0444	.0227	.0254	.0261	.0416	.0433	.0536	.0440	.0405	138
Land Development	---	---	.0096	---	---	---	---	---	---	---	.0096	1
Relocation	.0097	---	---	.0049	.0104	---	---	.0048	---	.0004	.0068	6
Relocation Payments	---	---	---	.0049	---	---	---	---	---	---	.0049	1
Demolition & Removal	---	---	---	---	.0100	---	---	---	---	.0454	.0277	2
Bond Interest	.0214	---	.0311	.0258	---	.0096	---	.0237	---	---	.0224	12
Contingency	.0564	.0608	.0497	.0693	.0286	.0378	.0517	.0520	.0623	.0368	.0470	321
Indirect Costs	---	.0048	.0022	---	---	---	---	---	.0059	---	.0037	7
Miscellaneous	.0164	---	---	.0431	---	.0072	.0385	.0051	.0418	.0437	.0297	25
Equipment	---	---	.0117	.0070	.0180	.0065	.0250	.0191	.0090	.0768	.0309	28
ELIGIBLE SUBTOTAL	.3604	.2995	.3128	.2838	.2637	.4462	.3031	.3887	.3473	.3732	.3937	---
Ineligible Costs	.0273	.0423	.1168	.0400	---	.0292	.1292	.2621	---	.0472	.1083	51
TOTALS	.3877	.3418	.4296	.3238	.2637	.4754	.4323	.6508	.3473	.4204	.5020	1498
									STEP 1/TCC		2.33	
									STEP 2/TCC		5.55	

Table 3.2 presents nonconstruction data corresponding to Table 3.1 for enlargement, upgrading, and enlargement and upgrading type treatment plant construction. In these cases the five most common nonconstruction costs equal approximately 22 percent of the total construction costs. Step I and Step II percentages equaled 5.00 percent and 7.41 percent, respectively, indicating that preliminary planning and plant design are somewhat more expensive for this type of project. Ineligible costs were significantly less on a percentage basis when they were present.

TABLE 3.2

AVERAGE NONCONSTRUCTION COST RATIOS FOR WASTEWATER TREATMENT PLANTS

ENLARGE, UPGRADE, ENLARGE AND UPGRADE
NONCONSTRUCTION COST/TOTAL CONSTRUCTION COSTS

STEP III NONCONSTRUCTION & COST CATEGORY	REG. 01	REG. 02	REG. 03	REG. 04	REG. 05	REG. 06	REG. 07	REG. 08	REG. 09	REG. 10	NATIONAL	SAMPLE SIZE
Administration/Legal	.0328	.0138	.0134	.0029	.0070	.0120	.0056	.0137	.0110	.0095	.0100	312
Preliminary	.0040	.0122	---	---	---	.0012	.0011	.0174	.0002	.0087	.0084	11
Land, Structures, Right-of-Way	.1024	.0136	.0120	---	.0427	.0176	.0059	.0381	.0953	.1457	.0477	24
A/E Basic Fees	.0208	.0684	.1483	.0400	.0811	.0469	.0357	.0522	.1013	.0630	.0805	321
Other A/E Fees	.0148	.0694	.0531	.0243	.0452	.0181	.0178	.0524	.0365	.0250	.0388	177
Inspection	.0506	.0418	.0452	.0248	.0289	.0243	.0354	.0706	.0348	.0402	.0422	111
Land Development	---	---	.0062	---	---	---	.0462	.0415	---	---	.0314	3
Relocation	---	---	.0035	.0023	---	---	---	---	.0016	---	.0023	4
Relocation Payments	---	---	---	---	---	---	---	---	---	---	---	0
Demolition & Removal	---	---	---	.0005	---	---	---	---	---	---	.0005	1
Bond Interest	---	.0171	.0407	.0014	---	---	---	---	---	---	.0198	3
Contingency	.0551	.0658	.0926	.0618	.0305	.0466	.0556	.0496	.0542	.0346	.0501	343
Indirect Costs	---	.0095	---	---	.0045	---	---	---	.0128	---	.0106	9
Miscellaneous	.0038	.0057	.0020	.0021	.0128	.0097	.0117	.0140	.0094	.0225	.0116	37
Equipment	.0025	---	.0406	.0099	.0010	---	.0274	.0078	.0408	.0154	.0237	19
ELIGIBLE SUBTOTAL	.2868	.3173	.4576	.1700	.2537	.1764	.2424	.3573	.3979	.3646	.3776	---
Ineligible Costs	.0015	.0145	.0776	.0144	---	.0018	.0428	.0917	.0161	---	.0470	34
TOTALS	.2883	.3318	.5352	.1844	.2537	.1782	.2852	.4490	.4140	.3646	.4246	1409
									STEP 1/TCC		5.00	
									STEP 2/TCC		7.41	

FIRST ORDER COSTS

New Construction Costs

First Order curves are presented in Figures 3.1 through 3.13 for the construction cost versus design flow (in mgd) for entirely new treatment facilities (grass roots or new construction). All grant eligible construction costs incurred in constructing the entire treatment facility are included. Only those relationships judged to be statistically significant were plotted. Statistical information concerning each relationship is shown on each plot.

Figures 3.1 through 3.8 present the total construction cost relationships for eight different levels of mechanical treatment plants from secondary treatment through advanced wastewater treatment (AWT) with nitrification and phosphorus removal. The levels of treatment are defined in Table 3.3.

TABLE 3.3

DEFINITION OF LEVELS OF TREATMENT

Treatment Level	Definition
Secondary Treatment	BOD_5 = 30 mg/1 (BOD_5 = 25 mg/1 where a State definition is more stringent than the EPA definition)
Advanced Secondary Treatment	BOD = 24 mg/1 - 11 mg/1
Advanced Wastewater Treatment	BOD $\leq$ 10 mg/1
Nitrification	Reduction of ammonia nitrogen to 5.0 mg/1 or less
Phosphorus Removal	Reduction of total phosphorus to 3.0 mg/1 or less.

The definitions of the treatment levels applied in this report are slightly different from those identified by EPA in the Construction Grants Program Requirements Memorandum 79-7 (March 9, 1979). The PRM 79-7 definitions are provided in Table 3.4.

TABLE 3.4

EPA DEFINITIONS FOR LEVELS OF TREATMENT

Treatment Level	Definition
Secondary Treatment	BOD_5 and Suspended Solids of 30/30 mg/l on a maximum monthly average or 85 percent removal, whichever is more stringent
Advanced Secondary Treatment	BOD_5 and Suspended Solids of 29/29 mg/l to 10/10 mg/l on a maximum monthly average
Advanced Wastewater Treatment	BOD_5 and Suspended Solids less than 10/10 mg/l or total nitorgen removal greater than 50 percent

Figures 3.9 through 3.13 present the construction cost curves for stabilization pond and aerated lagoon facilities. As with the preceding mechanical plant curves, the costs represented include the grant eligible costs for the entire facility including such costs as influent pumping, pretreatment, and effluent structures where they were found in the projects collected.

Other Types of Construction

Many projects which consist of enlargements, upgrading, and enlargement and upgrading of treatment facilities are also present in the data base. Due to the greater variation in technical considerations and costs associated with such projects, no cost curves could be produced at a level of statistical confidence great enough for inclusion as First Order curves.

Two other methods are suggested for the user to derive such costs. The first method is to use a summation of the Second Order curves to approximate the modifications to be made at a given facility. Alternatively, the user can refer to the simplified cost estimating techniques found in Section 4.0.

Total Project Costs

The user may derive total grant eligible project cost estimates by adding nonconstruction costs and Step I and Step II planning costs to the construction costs from the First Order cost curves. Table 3.5 below summarizes total project costs for mechanical secondary treatment at three design capacities.

TABLE 3.5

TOTAL PROJECT COSTS - SECONDARY TREATMENT

	Design Flow (mgd)		
	1.0	10.0	20.0
Total Construction Costs	$2,240,000	$12,030,000	$19,953,000
Step III Nonconstruction Costs (20%)*	448,000	2,406,000	3,991,000
Step I Costs (2.33%)	52,000	280,000	465,000
Step II Costs (5.55%)	124,000	668,000	1,107,000
TOTAL PROJECT COSTS	$2,864,000	$15,384,000	$25,516,000

* These costs include only the five most common nonconstruction costs from Table 3.1. Administrative/ Legal, Basic Architect/Engineering, Other Architect/ Engineering, Inspection, and Contingency costs. The user should use his own discretion concerning other categories of nonconstruction costs to be included.

Cost Updating

The costs in this report are all national average costs which have been indexed to Kansas City/St. Joseph, Missouri during the fourth calendar quarter of 1978. The use of Kansas City/St. Joseph, Missouri as base cities for the costs results from the use of a combination of the EPA Large City Advanced Treatment (LCAT) and Small City Conventional Treatment Indexes as discussed in Appendix A. Costs may be updated to other geographical areas by using the following procedure:

$$\text{Total Project Cost from this Report} \times \frac{\text{Latest LCAT or SCCT Index for Desired Area}}{\text{4th Quarter 1978 LCAT or SCCT Index for Desired Area}} = \text{Updated Cost}$$

The desired LCAT or SCCT Index city may be determined by using the maps, Figures A.1 or A.2 in Appendix A. The LCAT and SCCT Indexes are published quarterly by EPA. Costs for plants at or above 15 mgd should be updated using the LCAT Index, while those for plants below 15 mgd should be updated using the SCCT Index.

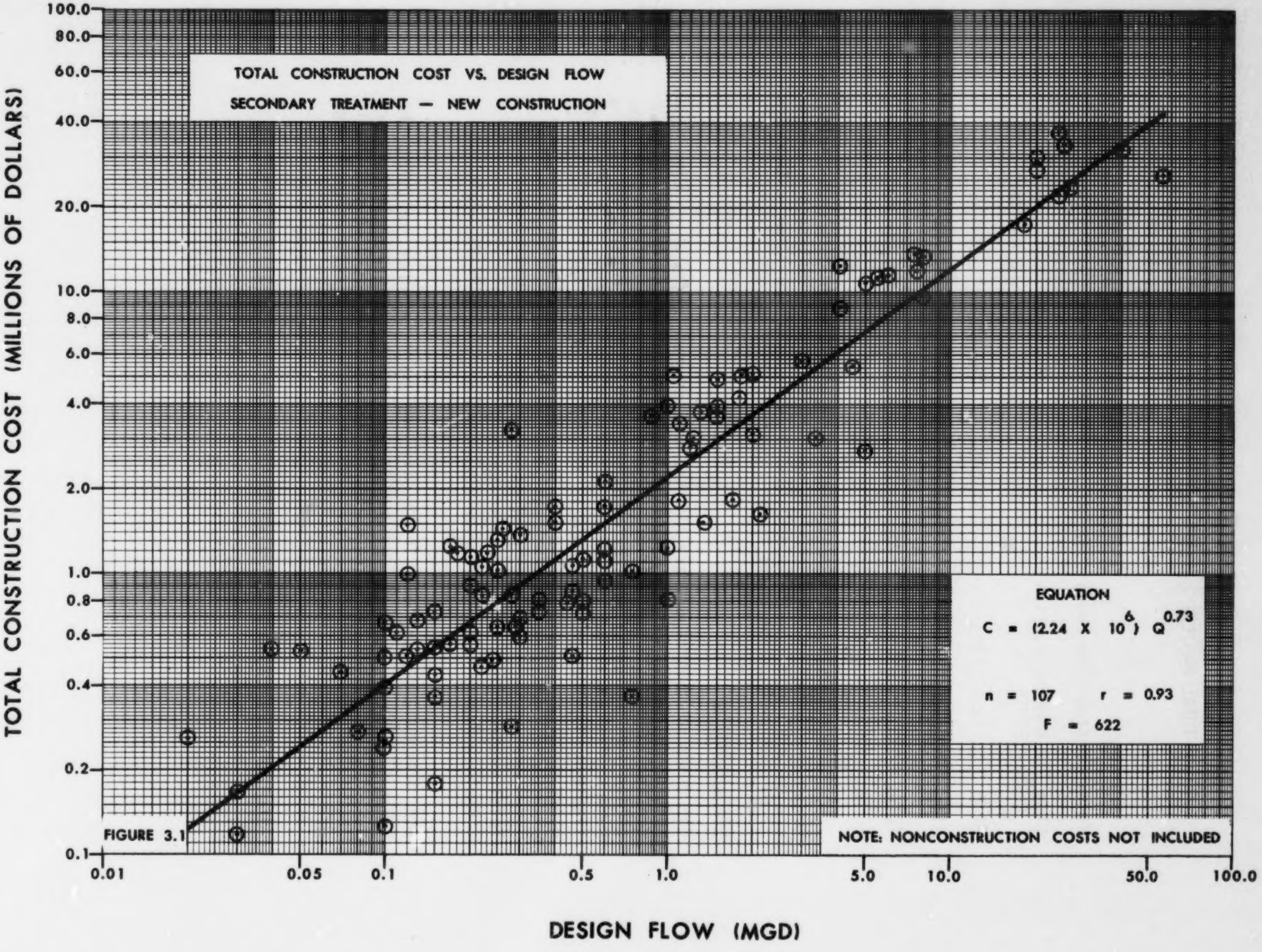


FIGURE 3.1

TOTAL CONSTRUCTION COST VS. DESIGN FLOW
SECONDARY TREATMENT — NEW CONSTRUCTION

EQUATION

$C = (2.24 \times 10^{6})\ Q^{0.73}$

$n = 107 \quad r = 0.93$

$F = 622$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

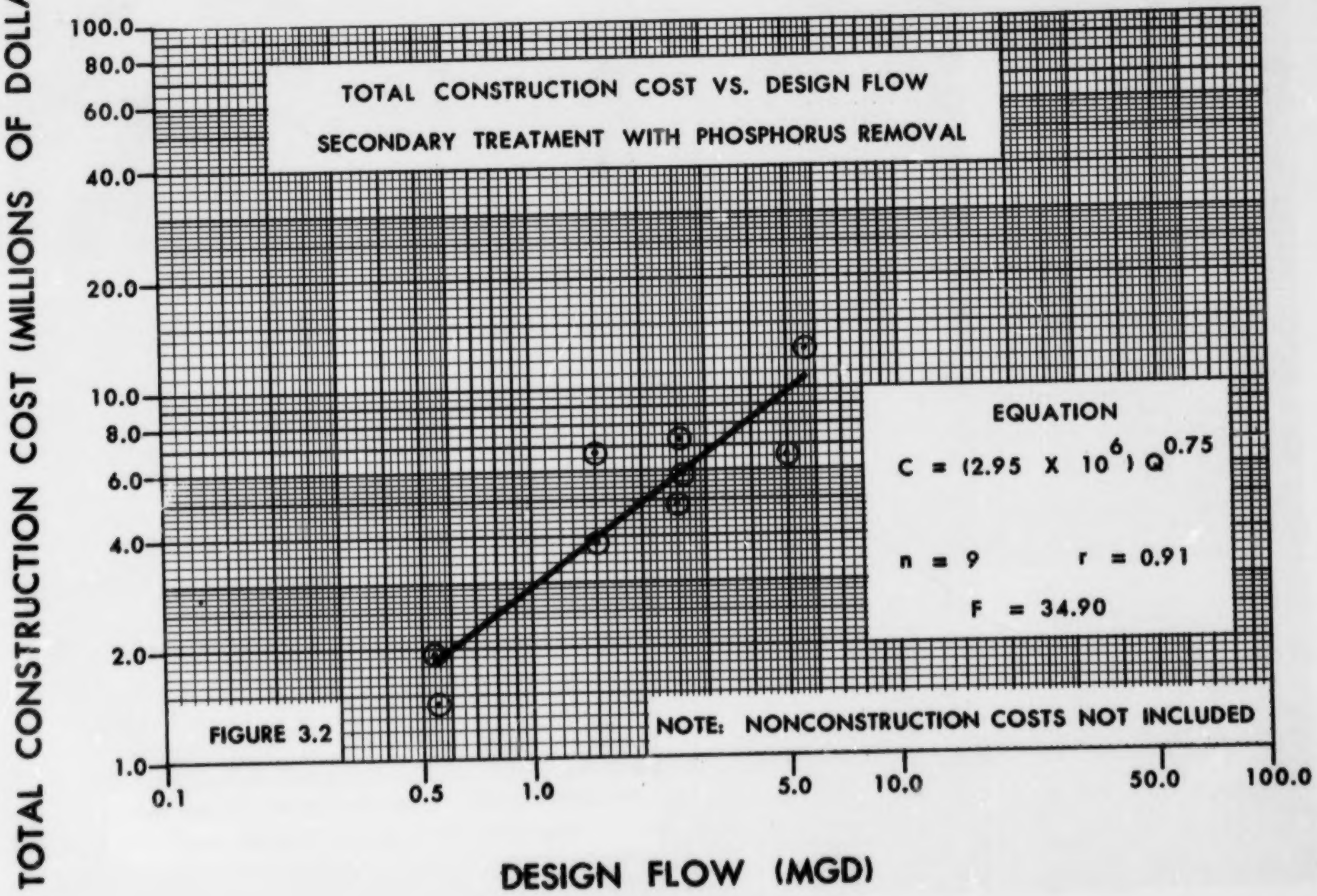


FIGURE 3.2

TOTAL CONSTRUCTION COST VS. DESIGN FLOW
SECONDARY TREATMENT WITH PHOSPHORUS REMOVAL

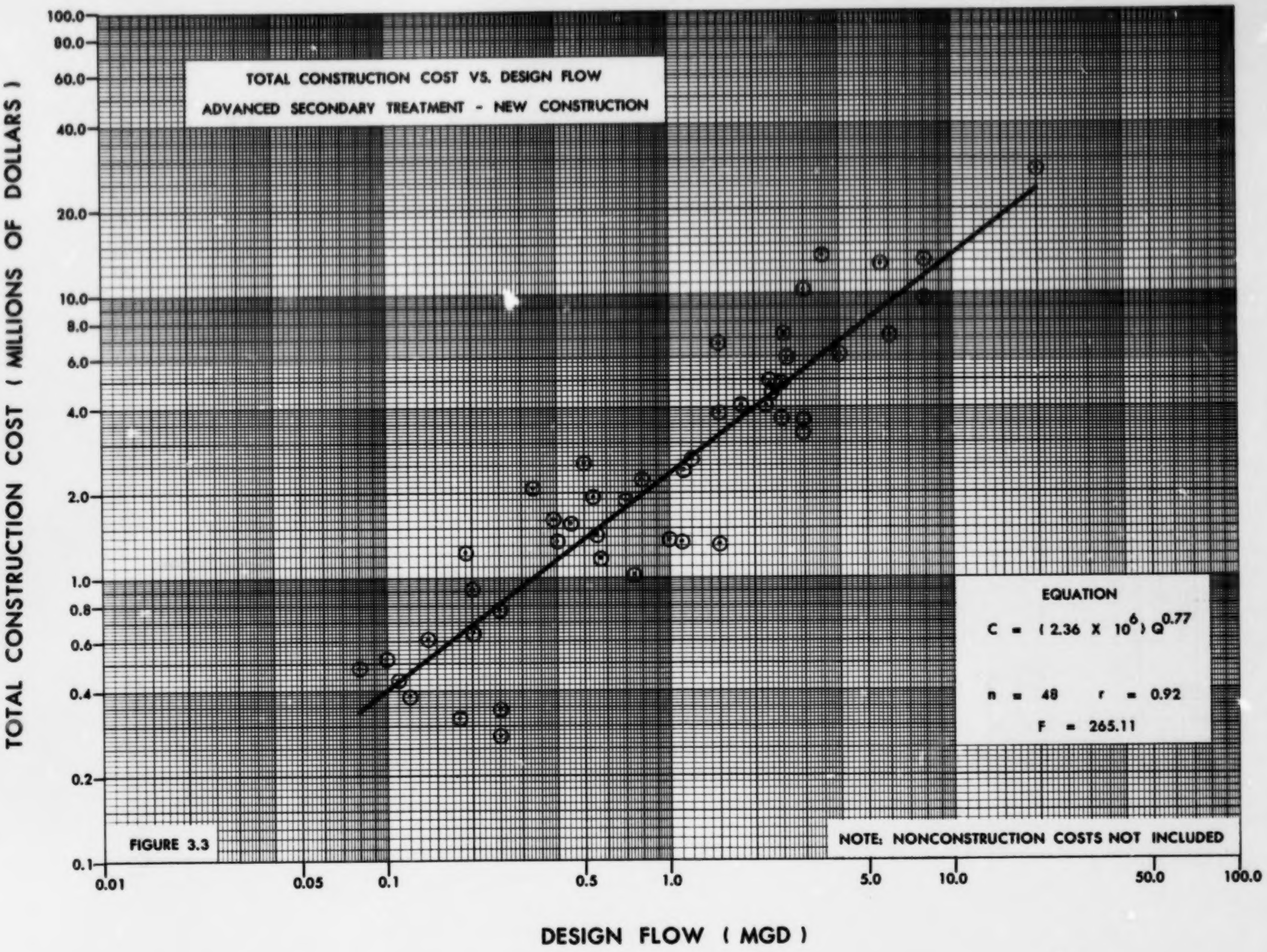
EQUATION

$C = (2.95 \times 10^{6})\, Q^{0.75}$

$n = 9 \qquad r = 0.91$

$F = 34.90$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



TOTAL CONSTRUCTION COST VS. DESIGN FLOW
ADVANCED SECONDARY TREATMENT - NEW CONSTRUCTION

EQUATION

$C = (2.36 \times 10^{6})\, Q^{0.77}$

$n = 48 \quad r = 0.92$

$F = 265.11$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.3

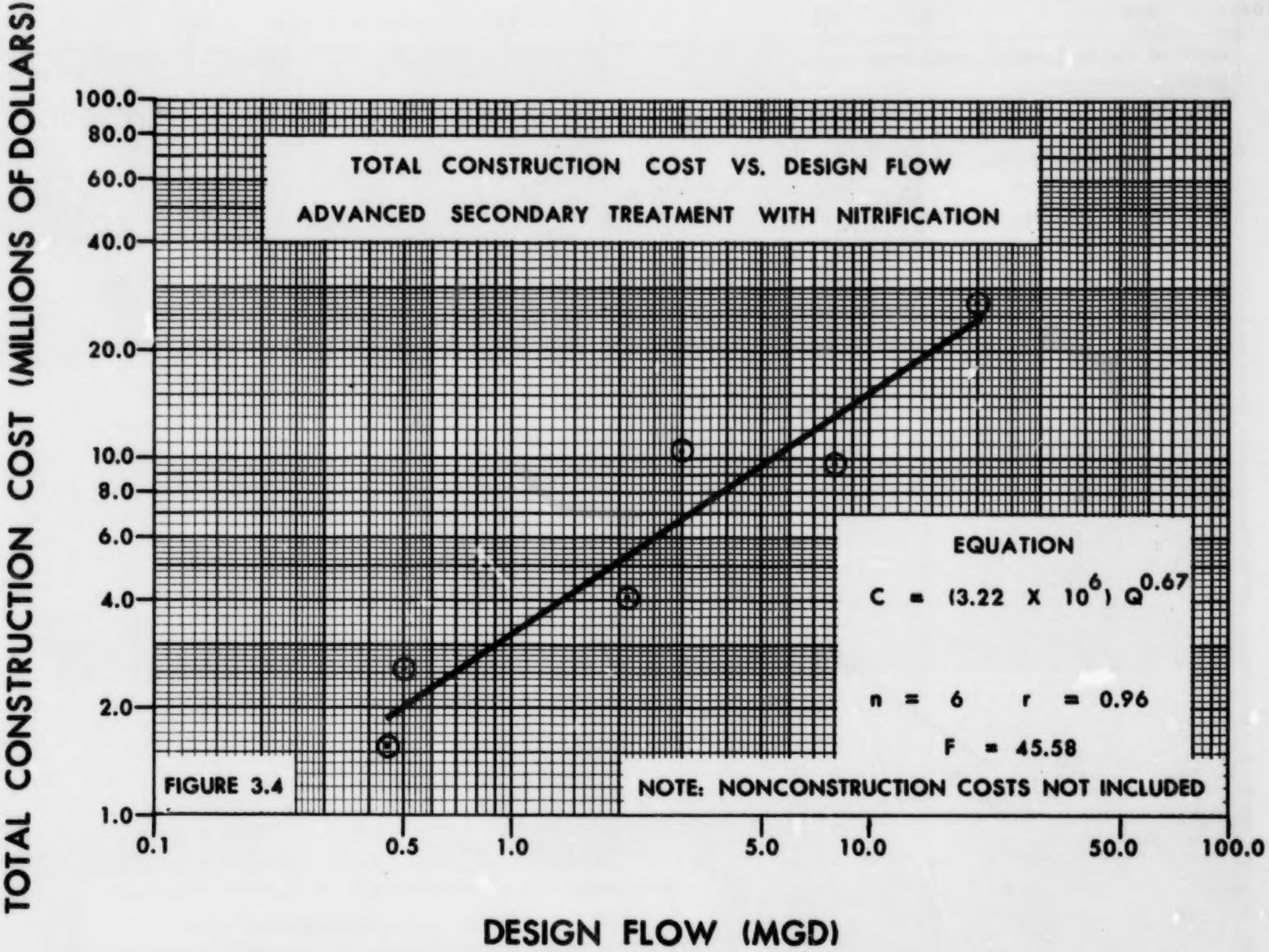

TOTAL CONSTRUCTION COST VS. DESIGN FLOW
ADVANCED SECONDARY TREATMENT WITH NITRIFICATION
EQUATION
C = (3.22 X 10⁶) Q^0.67
n = 6 r = 0.96
F = 45.58
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
TOTAL CONSTRUCTION COST (MILLIONS OF DOLLARS)
100.0
80.0
60.0
40.0
20.0
10.0
8.0
6.0
4.0
2.0
1.0
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.4

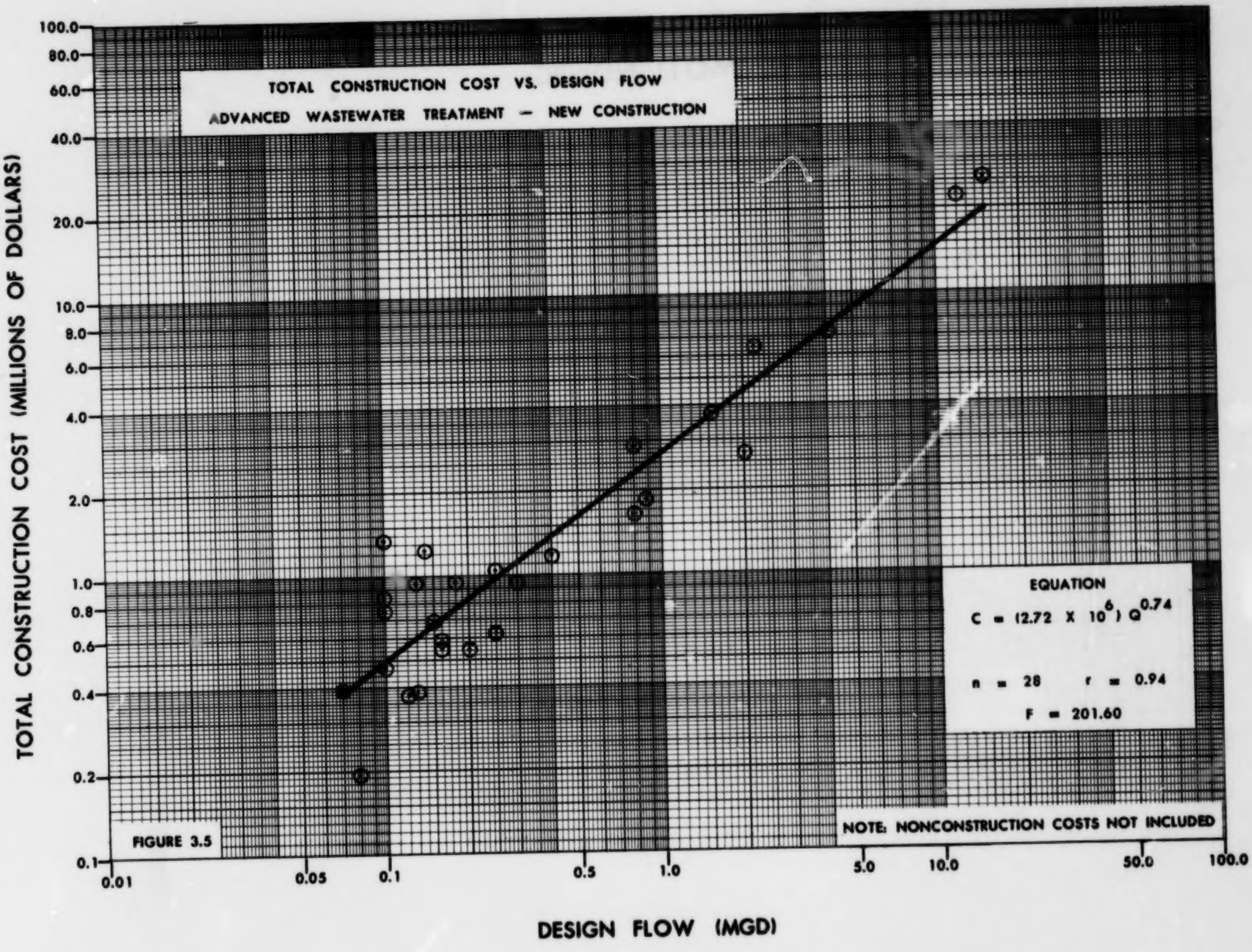


FIGURE 3.5

TOTAL CONSTRUCTION COST VS. DESIGN FLOW

ADVANCED WASTEWATER TREATMENT — NEW CONSTRUCTION

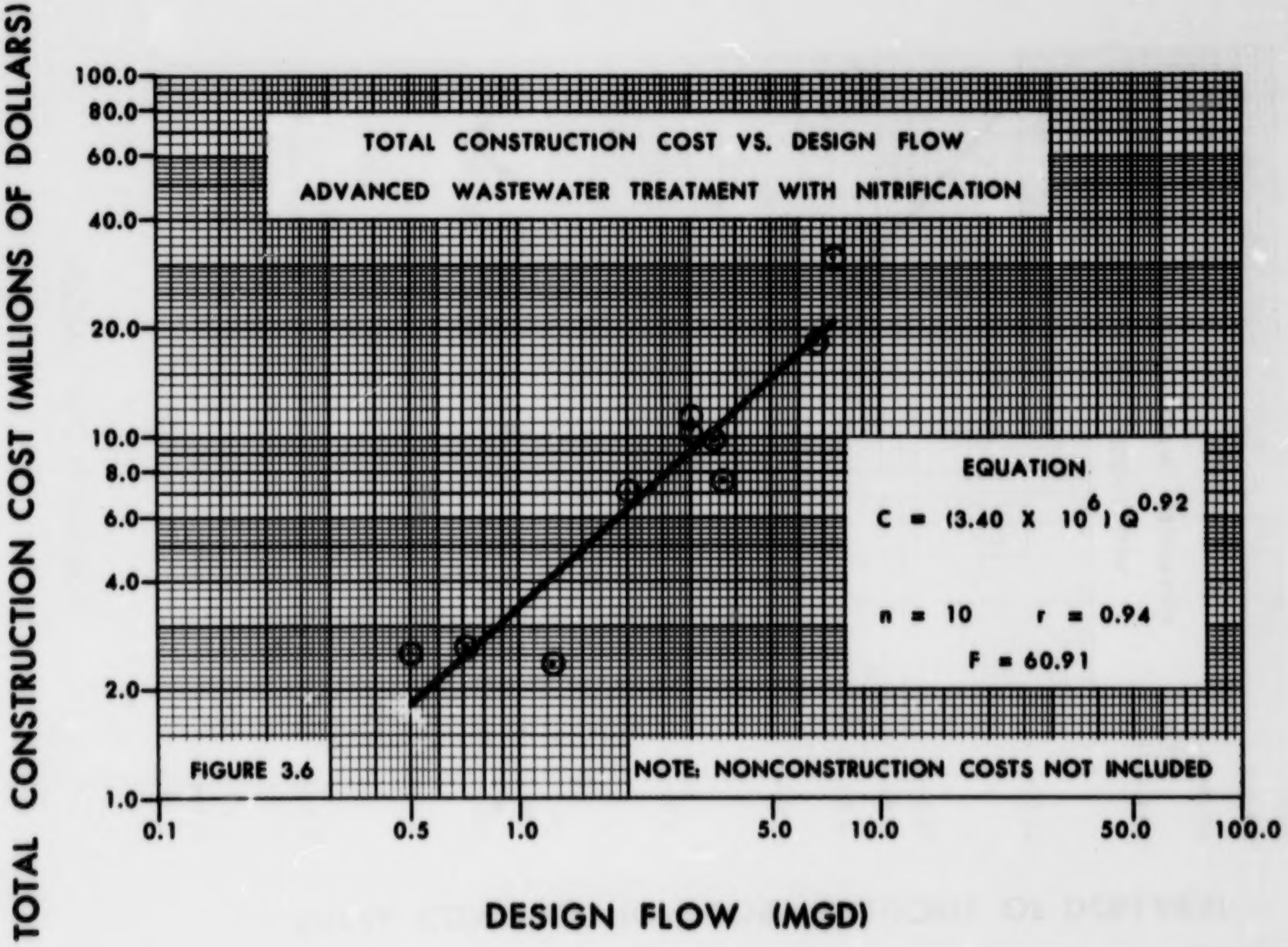


FIGURE 3.6

TOTAL CONSTRUCTION COST VS. DESIGN FLOW
ADVANCED WASTEWATER TREATMENT WITH NITRIFICATION

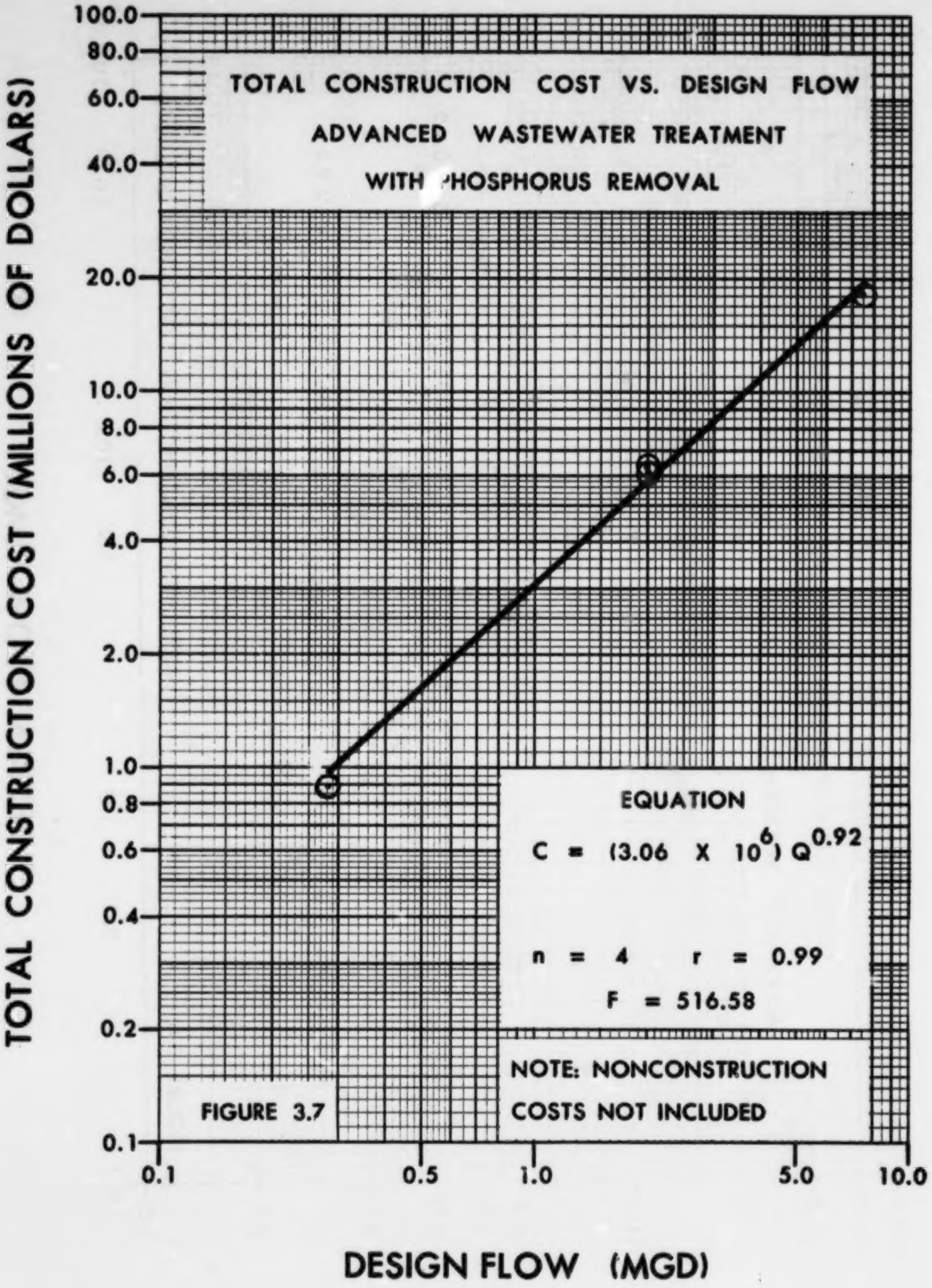
EQUATION

$C = (3.40 \times 10^{6})\, Q^{0.92}$

$n = 10 \quad r = 0.94$

$F = 60.91$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED


TOTAL CONSTRUCTION COST VS. DESIGN FLOW

ADVANCED WASTEWATER TREATMENT

WITH PHOSPHORUS REMOVAL

EQUATION

$C = (3.06 \times 10^{6})\, Q^{0.92}$

$n = 4 \quad r = 0.99$

$F = 516.58$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.7

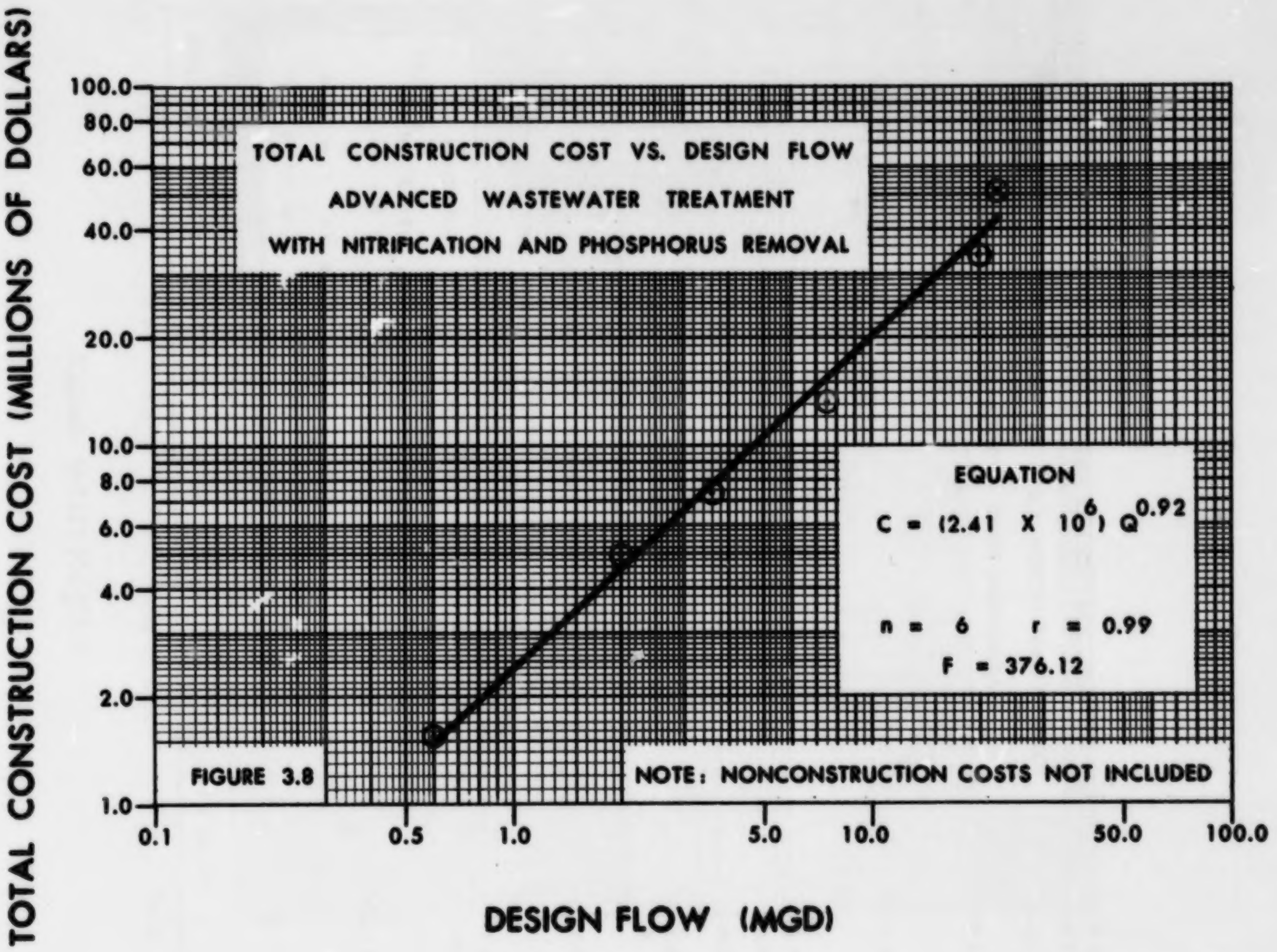
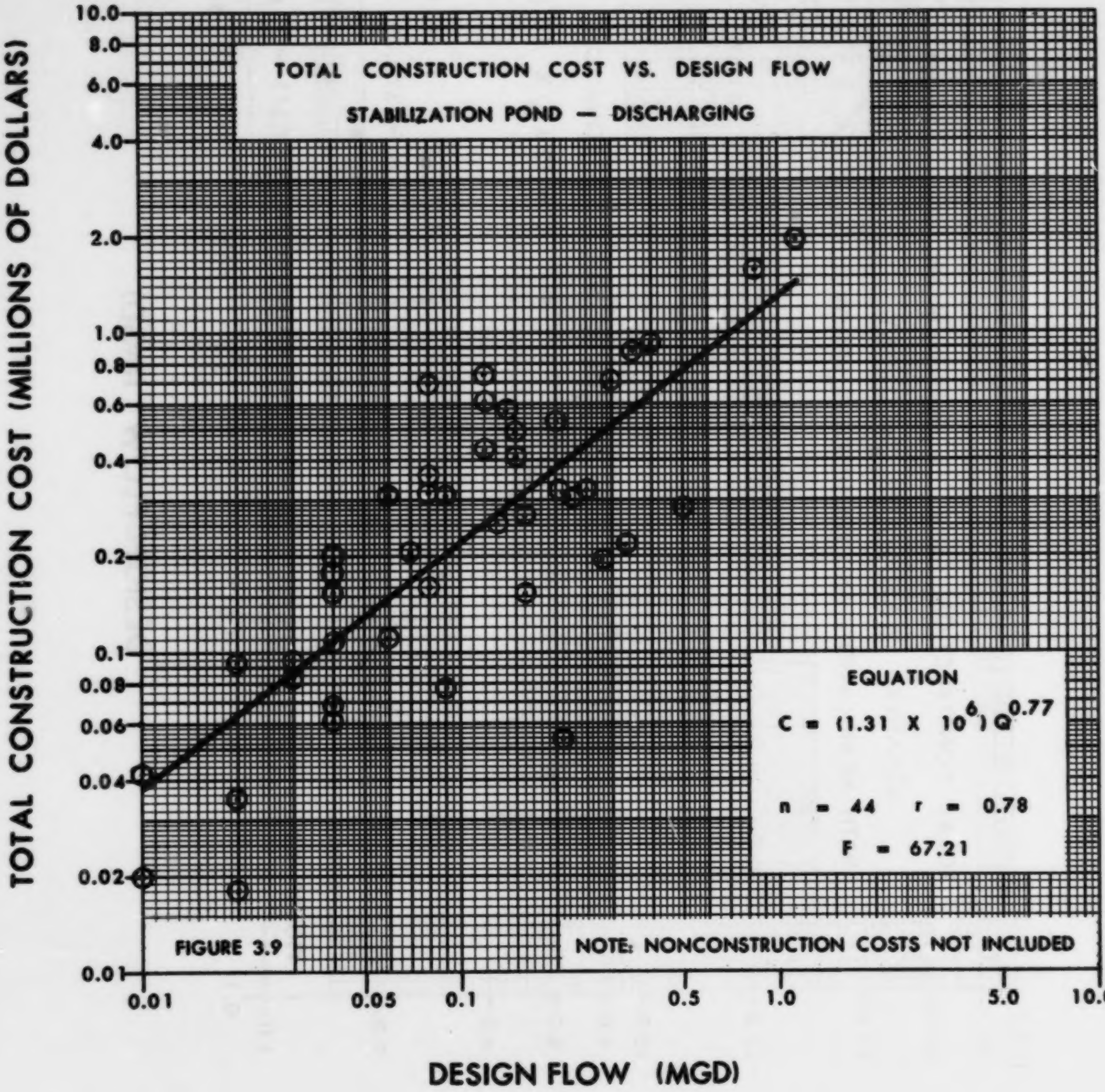

TOTAL CONSTRUCTION COST VS. DESIGN FLOW
ADVANCED WASTEWATER TREATMENT
WITH NITRIFICATION AND PHOSPHORUS REMOVAL
EQUATION
C = (2.41 X 10^6) Q^0.92
n = 6 r = 0.99
F = 376.12
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
TOTAL CONSTRUCTION COST (MILLIONS OF DOLLARS)
100.0
80.0
60.0
40.0
20.0
10.0
8.0
6.0
4.0
2.0
1.0
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.8



TOTAL CONSTRUCTION COST VS. DESIGN FLOW
STABILIZATION POND — DISCHARGING

EQUATION

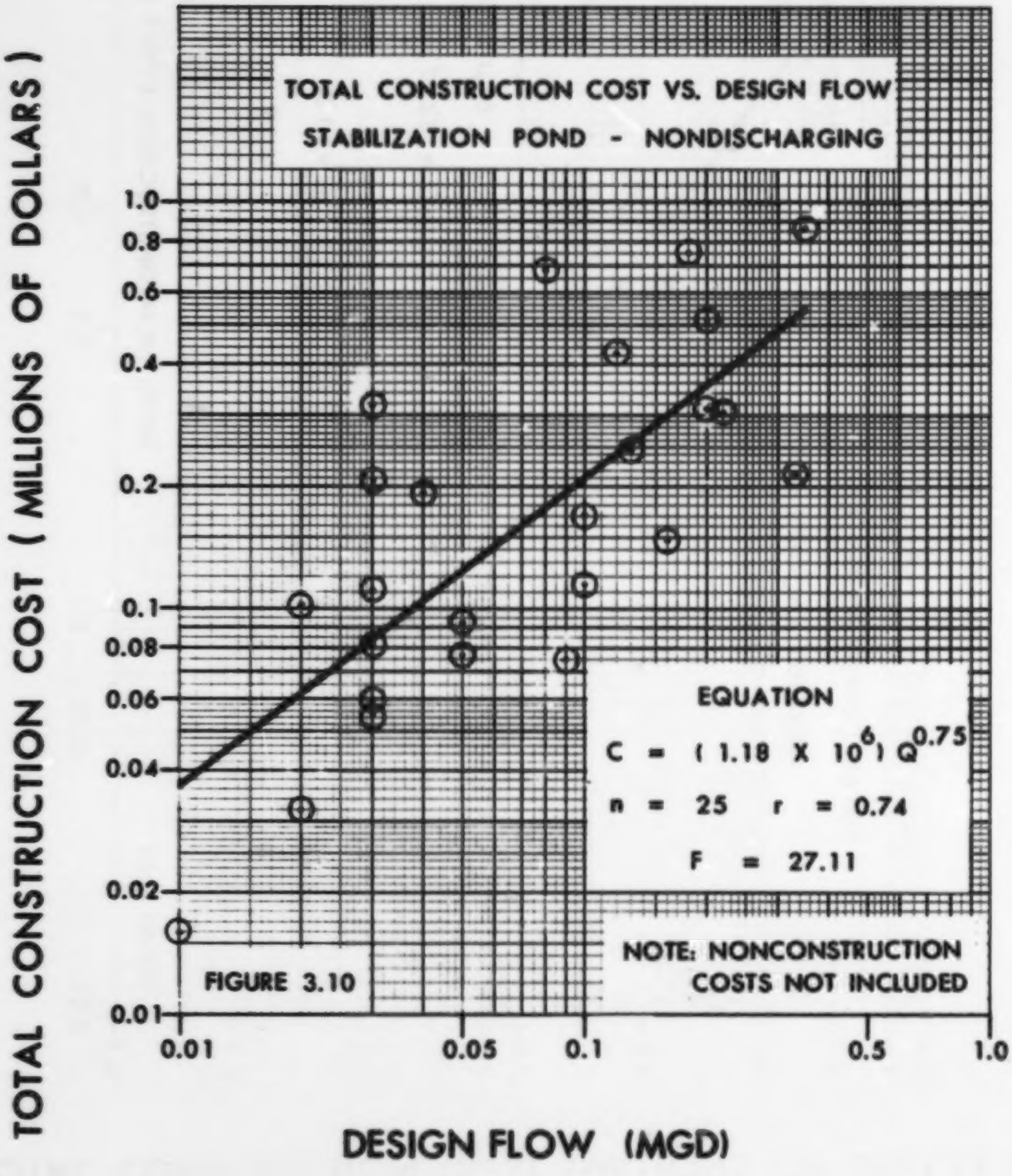
$C = (1.31 \times 10^6) Q^{0.77}$

$n = 44 \quad r = 0.78$

$F = 67.21$

FIGURE 3.9

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED


TOTAL CONSTRUCTION COST VS. DESIGN FLOW
STABILIZATION POND - NONDISCHARGING
EQUATION
C = (1.18 X 10^6) Q^0.75
n = 25 r = 0.74
F = 27.11
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
FIGURE 3.10
TOTAL CONSTRUCTION COST (MILLIONS OF DOLLARS)
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.01
0.05
0.1
0.5
1.0
DESIGN FLOW (MGD)

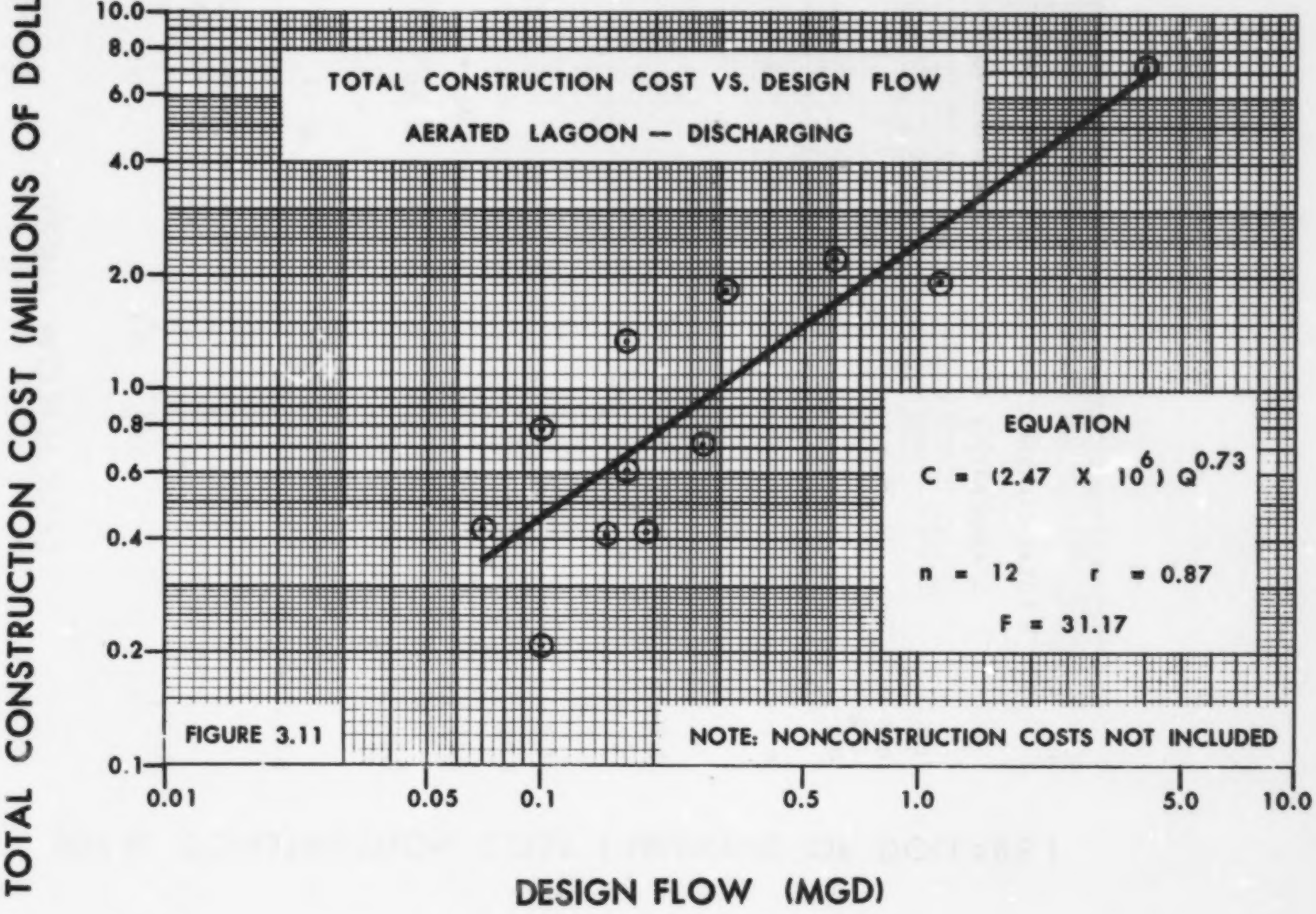
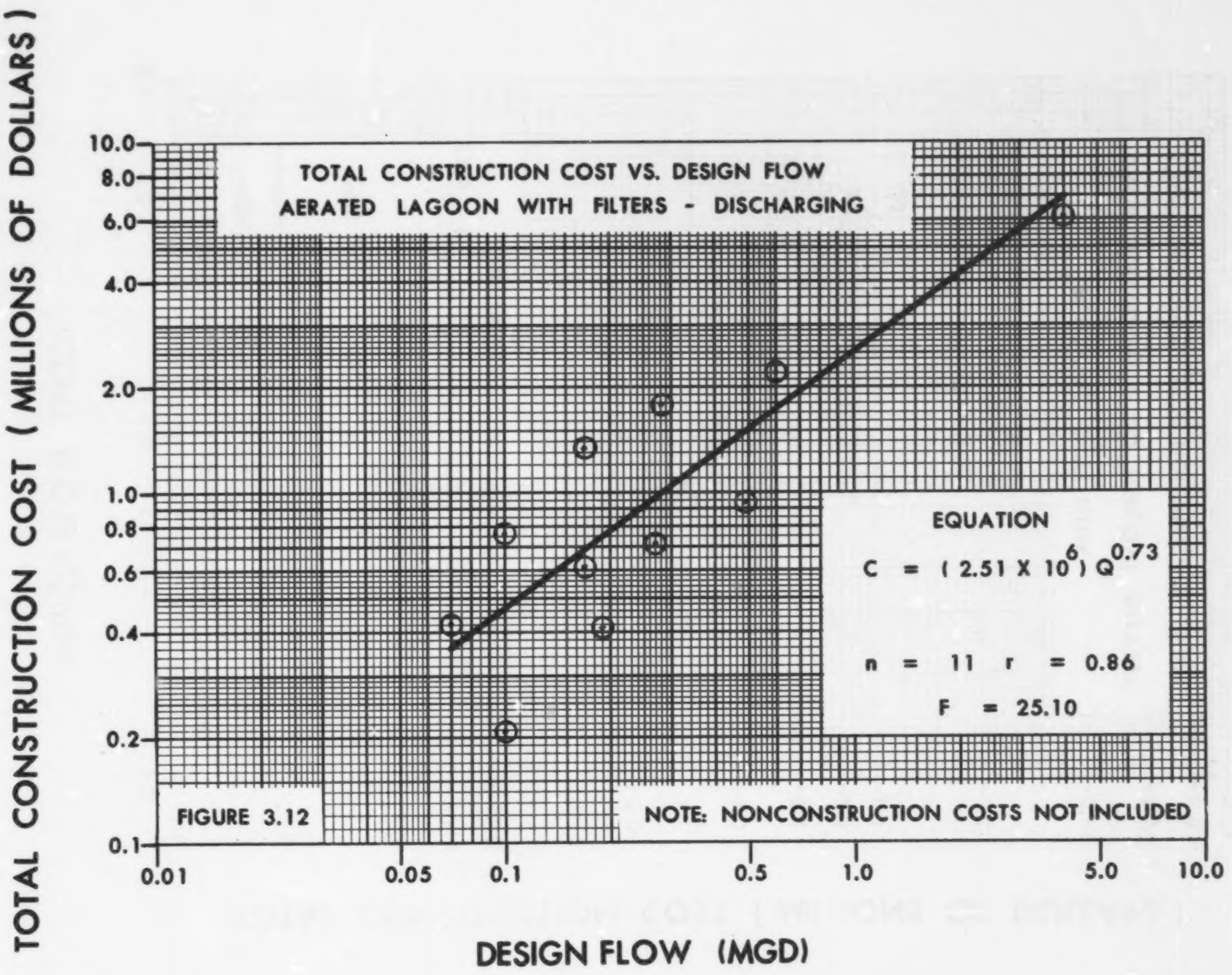


FIGURE 3.11

TOTAL CONSTRUCTION COST VS. DESIGN FLOW

AERATED LAGOON — DISCHARGING



TOTAL CONSTRUCTION COST VS. DESIGN FLOW
AERATED LAGOON WITH FILTERS - DISCHARGING

FIGURE 3.12

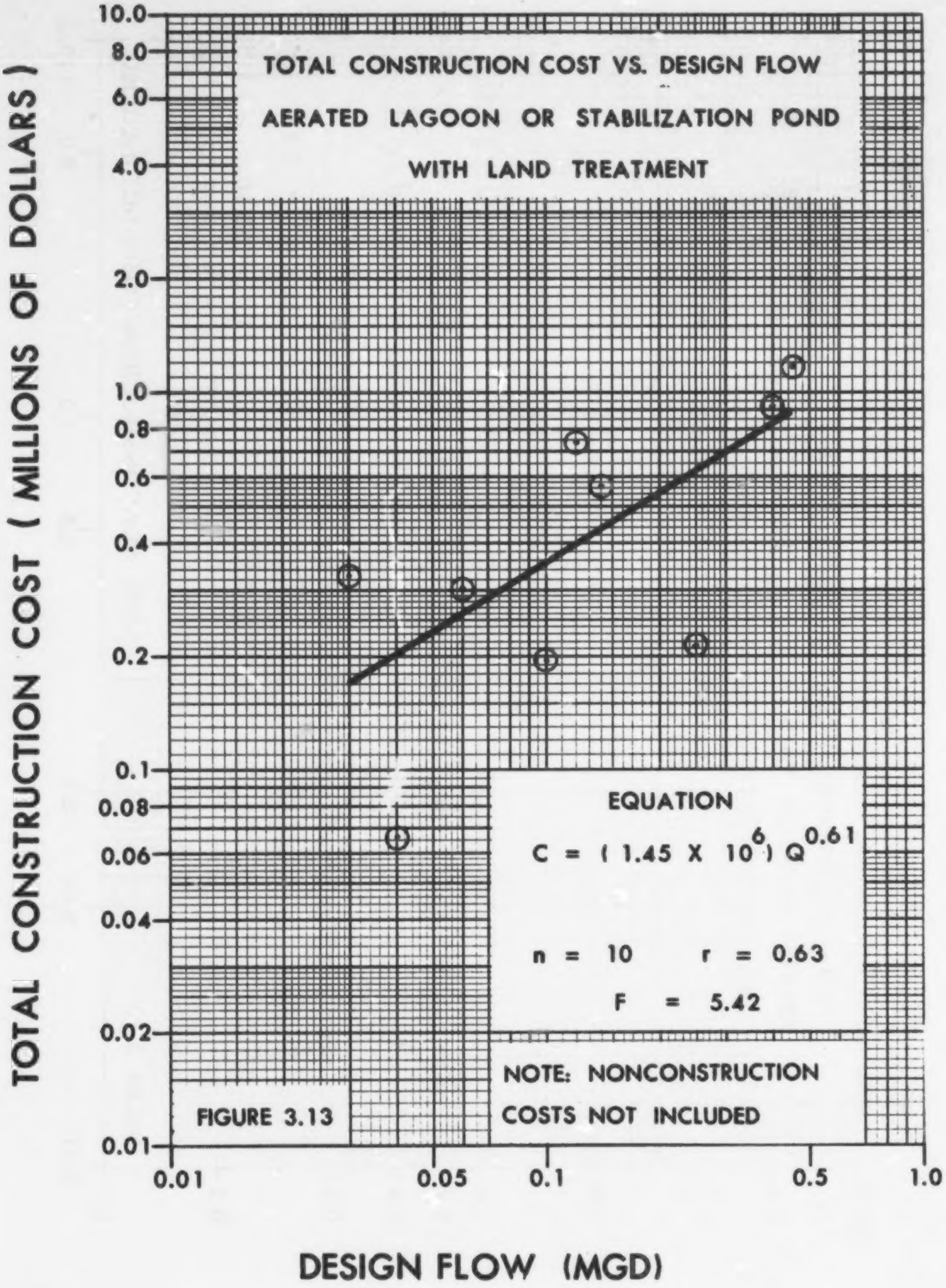
EQUATION

$C = (2.51 \times 10^{6})\, Q^{0.73}$

$n = 11 \quad r = 0.86$

$F = 25.10$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



TOTAL CONSTRUCTION COST VS. DESIGN FLOW

AERATED LAGOON OR STABILIZATION POND

WITH LAND TREATMENT

EQUATION

$$C = (1.45 \times 10^{6})\, Q^{0.61}$$

n = 10   r = 0.63

F = 5.42

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.13

SECOND ORDER COSTS

Unit Process Construction Costs

Second Order plots of construction cost versus design flow for 30 commonly used unit processes are included as Figures 3.14 through 3.43. These costs are derived from data for newly constructed unit processes even though some of these processes were constructed as a part of a project to enlarge and/or upgrade an existing plant. Costs for the enlargement and/or upgrading of unit processes were too variable and have not been included.

In order to insure that costs for identical types of unit processes were comparable, the definitions of all unit processes with respect to their construction components were determined. The following construction components were included in the costs for all unit processes:

1. Concrete
2. Equipment
3. Process Piping
4. Steel

The following unit processes include excavation costs in addition to the components listed above:

1. Aerated Lagoons
2. Flow Equalization
3. Sludge Drying Beds
4. Sludge Lagoons
5. Stabilization Ponds

Unit process costs which included other component costs not in the above lists or which did not contain all of the above cost elements were not eligible for inclusion into this analysis.

Figure 3.33, Effluent Outfall - Ocean Outfall, is significant in that the equation has an exponent of greater than 1.00. This would imply that there is no economy of scale for ocean outfalls. In order to verify this, more data were collected for 11 of the 13 data points included in Figure 3.33. As a result, it was found that the larger treatment plants tended to require the longer ocean outfalls and a bigger pipe.

Second Order Component Costs

Component costs for total plant construction were often bid on a lump sum basis and could be easily separated from the total bid price. These are referred to as total plant component costs and should not be confused with the Third Order component costs.

The total plant component costs most commonly available were:

1. Controls and Instrumentation
2. Electrical
3. Excavation
4. Heating, Ventilation, and Air Conditioning
5. Mobilization
6. Pilings, Special Foundations, and Dewatering
7. Sitework
8. Yard Piping

Figures 3.44 through 3.57 present the plots of the total plant component cost versus design flow for new construction of all levels of treatment. The component cost analysis includes both labor and materials. These "in place" costs are in addition to the second order unit process costs.

Use of the Second Order Curves

Unit process Second Order costs and total plant component costs may be combined to yield complete treatment plant construction costs as shown by the example in Table 3.6 for a typical activated sludge treatment plant.

TABLE 3.6

TOTAL CONSTRUCTION COSTS - ACTIVATED SLUDGE SECONDARY TREATMENT

Process Name	Design Flow (mgd)		
	1.0	10.0	20.0
Preliminary Treatment	$ 64,000	$ 370,000	$ 627,000
Influent Pumping	131,000	559,000	865,000
Primary Sedimentation	120,000	601,000	977,000
Conventional Activated Sludge	519,000	2,919,000	4,908,000
Effluent Chlorination	63,000	283,000	444,000
Effluent Outfall	61,000	359,000	613,000
Gravity Thickening	69,000	346,000	563,000
Aerobic Digestion	199,000	1,199,000	2,059,000
Drying Beds	69,000	374,000	618,000
Control/Lab/Maintenance Building	193,000	734,000	1,097,000
TOTAL UNIT PROCESS COSTS	$1,488,000	$ 7,744,000	$12,771,000
Mobilization	63,000	311,000	501,000
Sitework	111,000	412,000	612,000
Excavation	133,000	581,000	905,000
Electrical	167,000	897,000	1,488,000
Controls and Instrumentation	78,000	469,000	805,000
Yard Piping	115,000	590,000	965,000
Heating, Ventilating, & Air Conditioning	48,000	312,000	547,000
TOTAL CONSTRUCTION COMPONENT COSTS	$ 715,000	$ 3,572,000	$ 5,823,000
TOTAL CONSTRUCTION COSTS	$2,203,000	$11,316,000	$18,594,000

The above total construction costs correspond to the First Order construction costs. When combined with Step I and II, plus Step III nonconstruction costs, total project costs are determined. Table 3.7 below presents the total project costs resulting from the above sample activated sludge facilities.

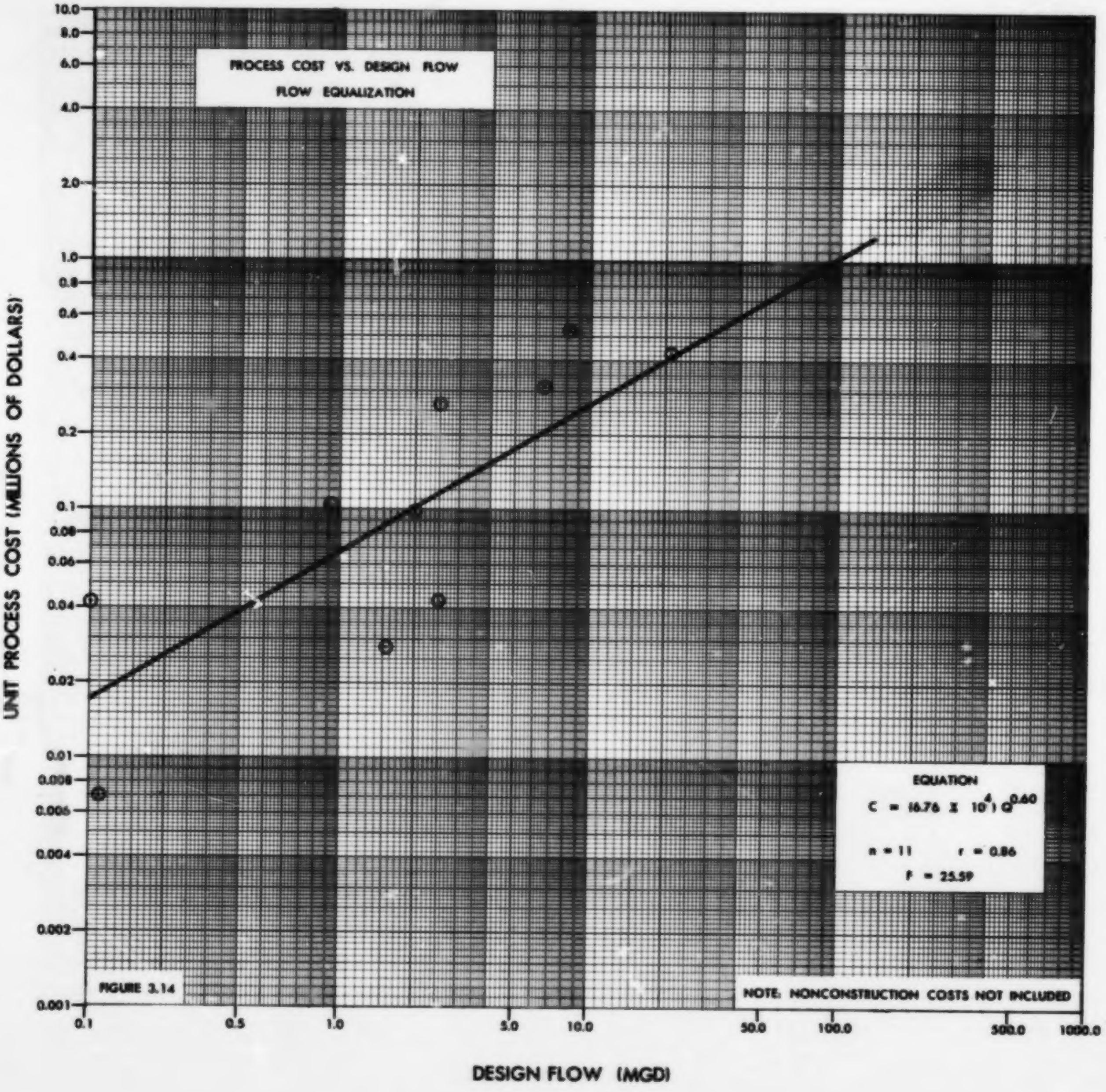
TABLE 3.7

TOTAL PROJECT COSTS - ACTIVATED SLUDGE SECONDARY TREATMENT

	Design Flow (mgd)		
	1.0	10.0	20.0
Total Construction Costs	$2,203,000	$11,315,000	$18,594,000
Step III Nonconstruction Costs * (20%)	440,000	2,263,000	3,719,000
Step I Costs *	51,000	264,000	433,000
Step II Costs *	122,000	628,000	1,032,000
TOTAL PROJECTED COSTS	$2,816,000	$14,470,000	$23,778,000

* From Table 3.1.

These costs agree well with the total project costs determined from the First Order cost curves (see Table 3.5). Some divergence of costs between the two levels of estimating is apparent, however, as design flow increases. This could be due to the fact that more complex unit process schemes than the one chosen in this example are commonly utilized for the larger facilities.



PROCESS COST VS. DESIGN FLOW

FLOW EQUALIZATION

FIGURE 3.14

EQUATION

$C = (6.76 \times 10^{4})\,Q^{0.60}$

$n = 11$ $r = 0.86$

$F = 25.59$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

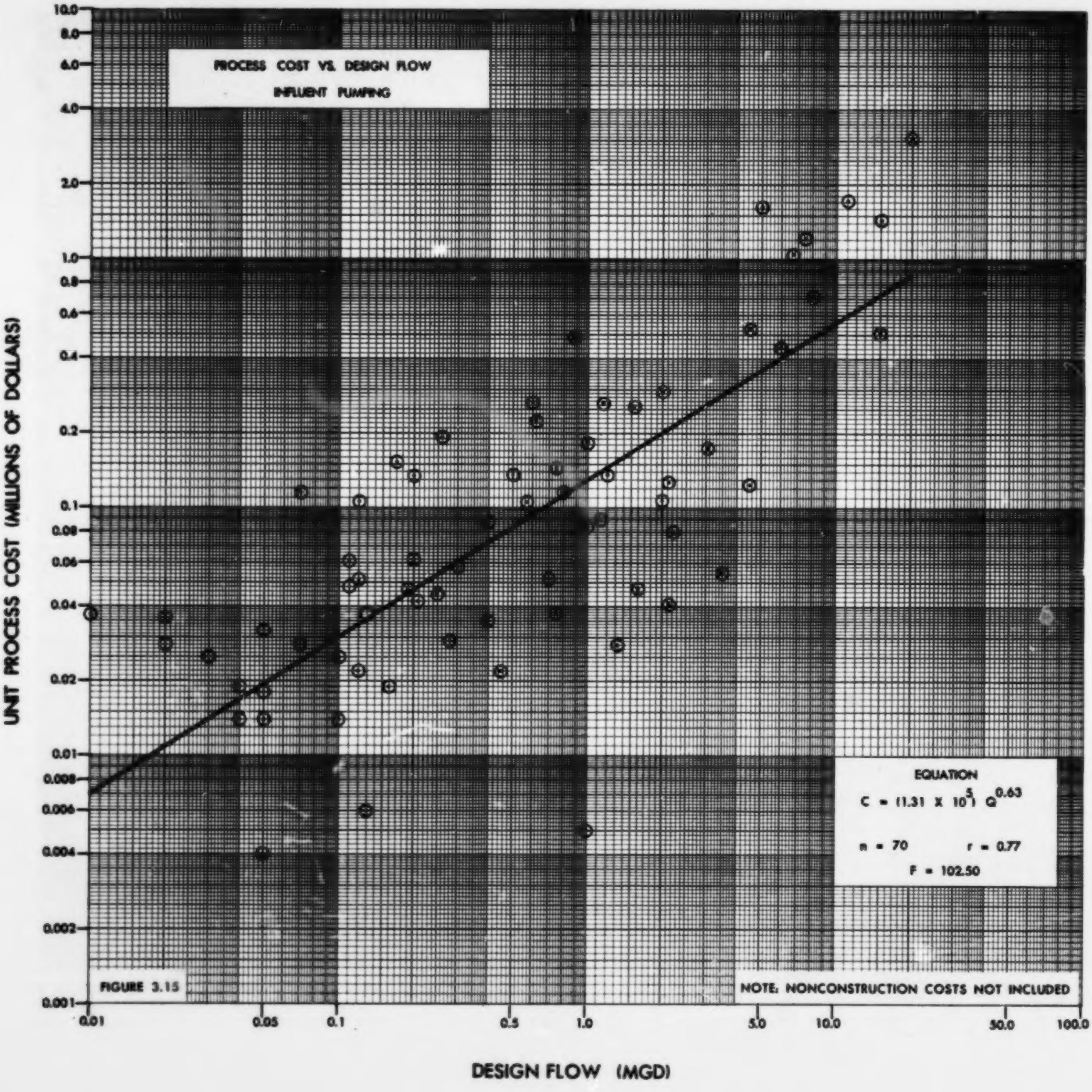

PROCESS COST VS. DESIGN FLOW
INFLUENT PUMPING
UNIT PROCESS COST (MILLIONS OF DOLLARS)
DESIGN FLOW (MGD)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
EQUATION
C = (1.31 X 10^5) Q^0.63
n = 70
r = 0.77
F = 102.50
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.15

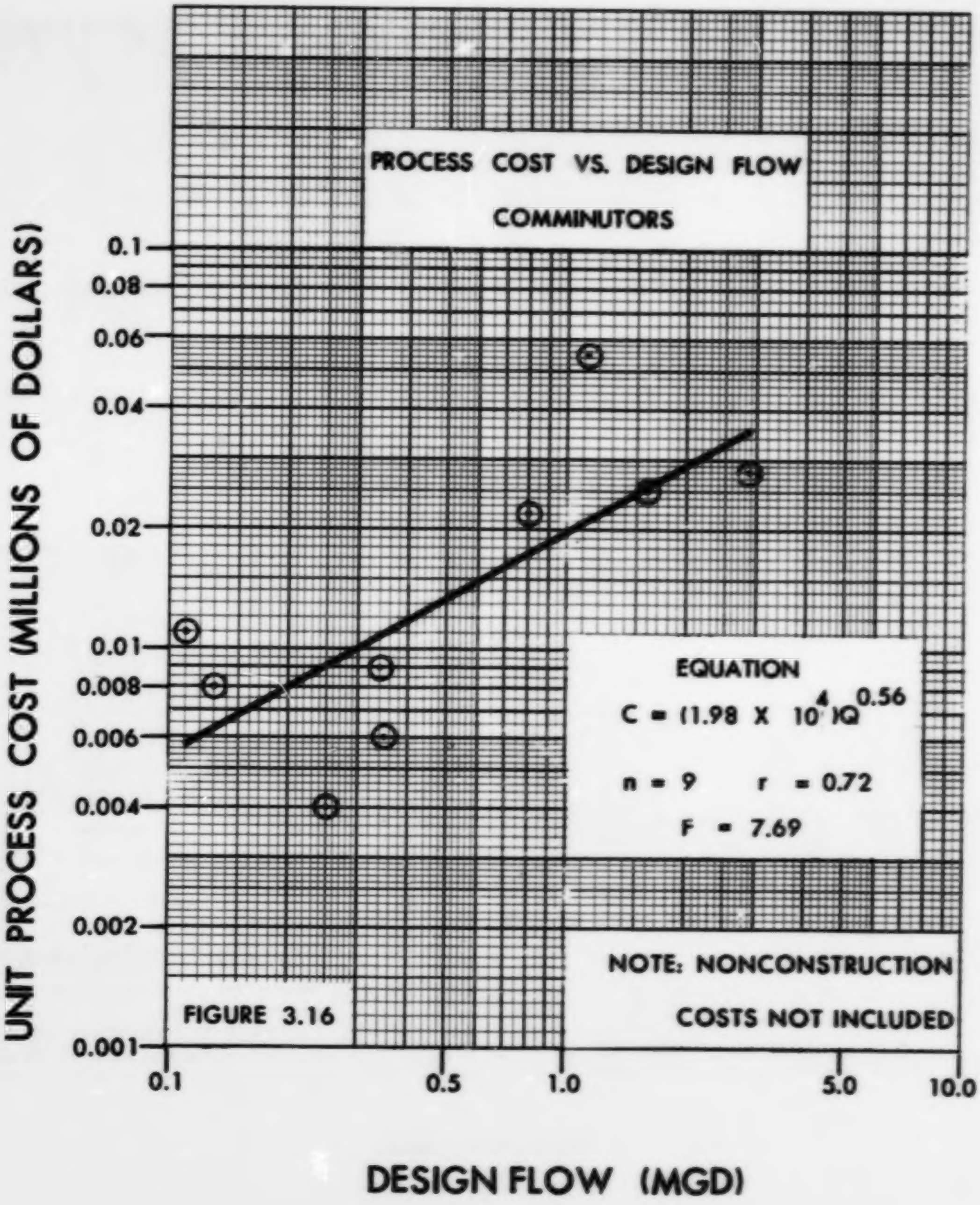


FIGURE 3.16

PROCESS COST VS. DESIGN FLOW

COMMINUTORS

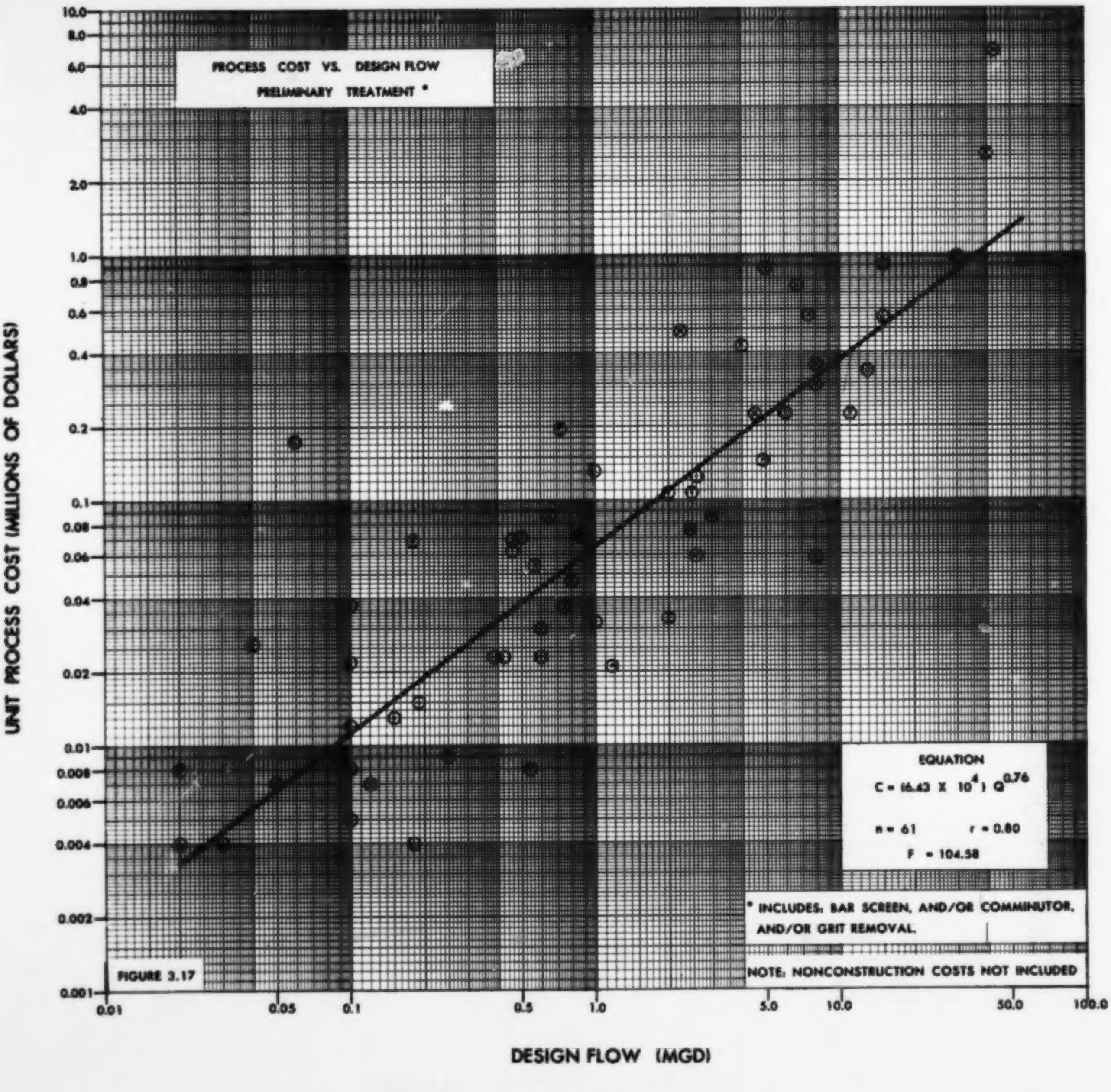
EQUATION

$C = (1.98 \times 10^{4})Q^{0.56}$

$n = 9 \quad r = 0.72$

$F = 7.69$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



$C = 16.43 \times 10^{4})\, Q^{0.76}$

* INCLUDES: BAR SCREEN, AND/OR COMMINUTOR, AND/OR GRIT REMOVAL.

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.17

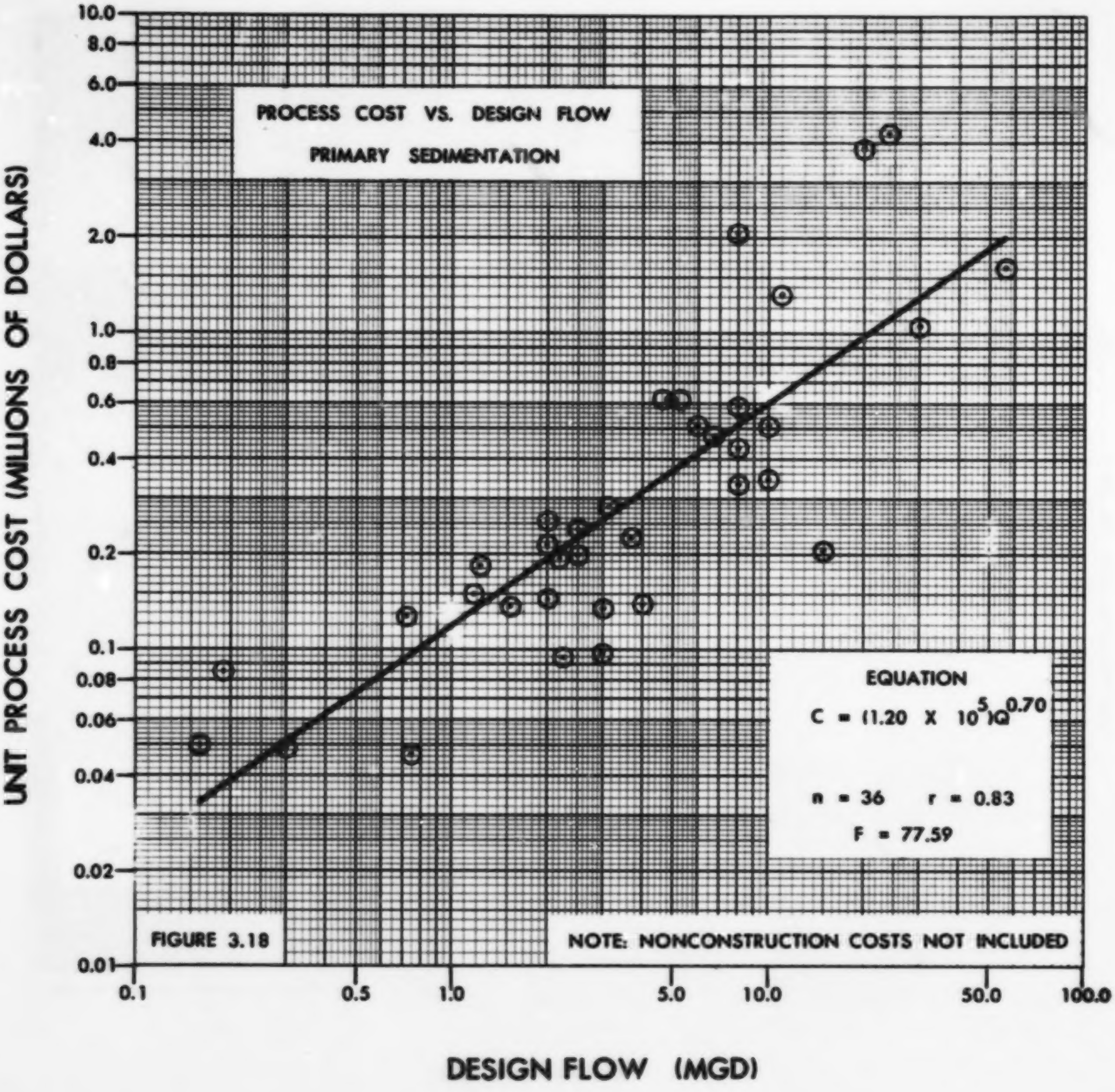

PROCESS COST VS. DESIGN FLOW
PRIMARY SEDIMENTATION
UNIT PROCESS COST (MILLIONS OF DOLLARS)
DESIGN FLOW (MGD)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
EQUATION
C = (1.20 X 10^5)Q^0.70
n = 36 r = 0.83
F = 77.59
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.18

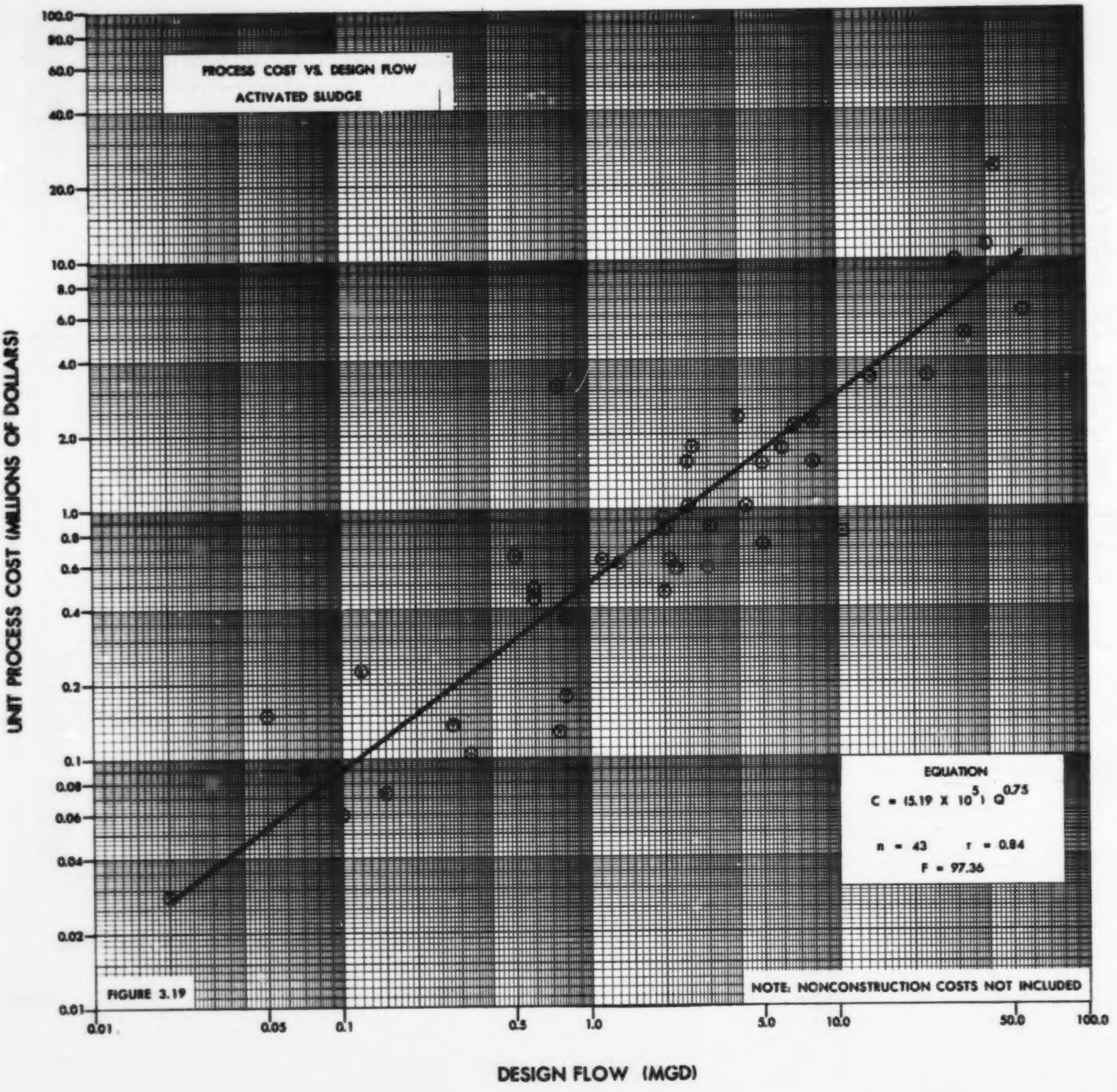

PROCESS COST VS. DESIGN FLOW
ACTIVATED SLUDGE
EQUATION
C = (5.19 X 10^5) Q^0.75
n = 43
r = 0.84
F = 97.36
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
UNIT PROCESS COST (MILLIONS OF DOLLARS)
100.0
80.0
60.0
40.0
20.0
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.19

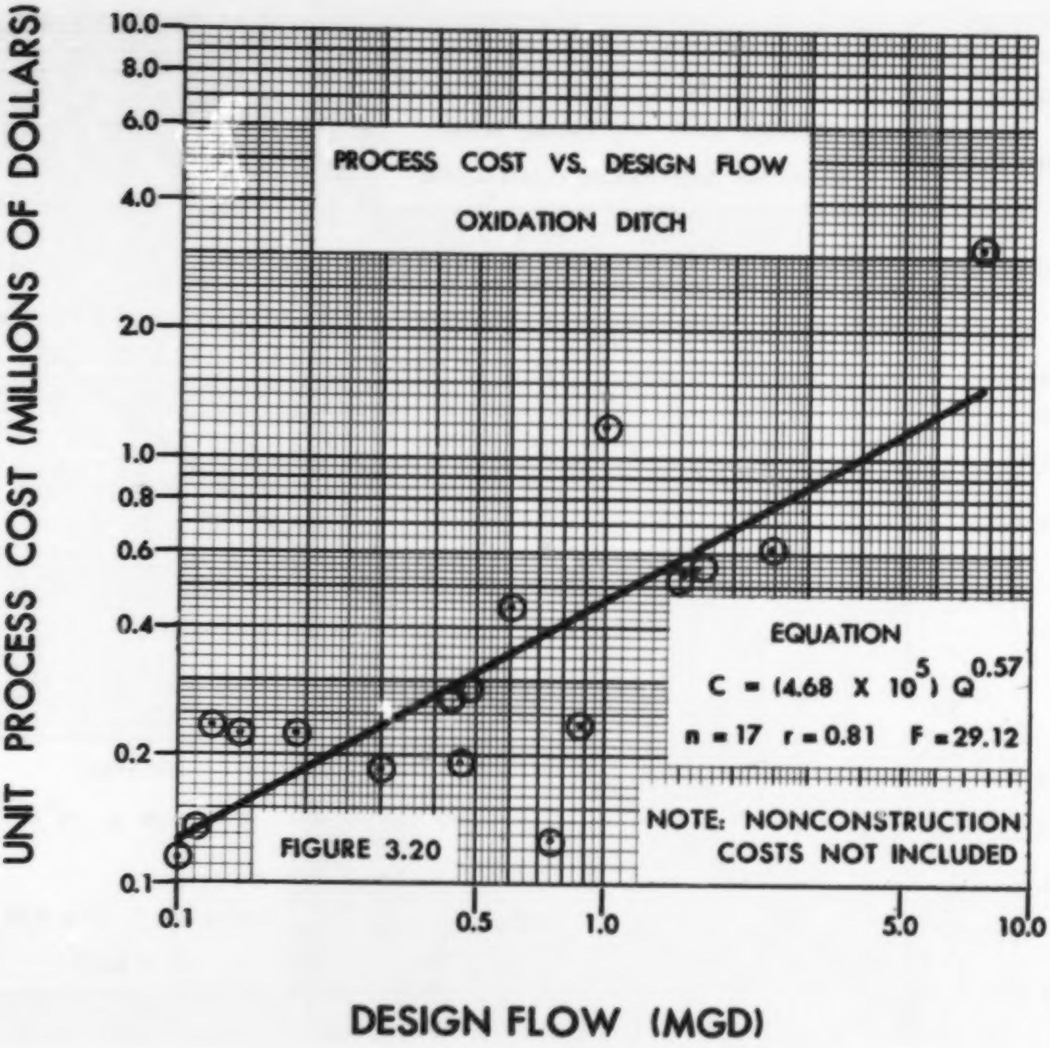


FIGURE 3.20

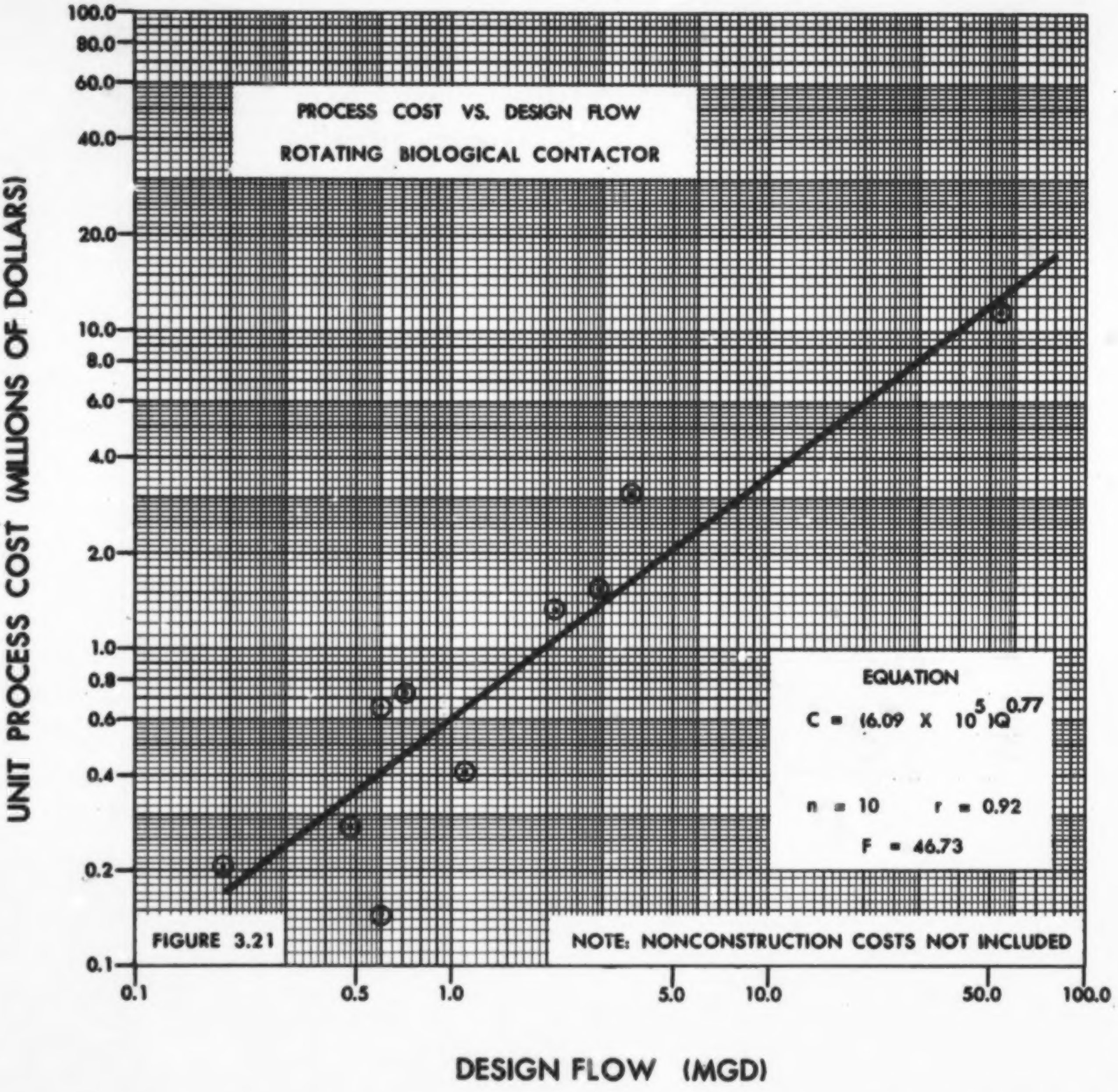
PROCESS COST VS. DESIGN FLOW
OXIDATION DITCH

EQUATION

$C = (4.68 \times 10^5) Q^{0.57}$

$n = 17 \quad r = 0.81 \quad F = 29.12$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



PROCESS COST VS. DESIGN FLOW
ROTATING BIOLOGICAL CONTACTOR

FIGURE 3.21

EQUATION

$C = (6.09 \times 10^5)Q^{0.77}$

$n = 10$ $r = 0.92$

$F = 46.73$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

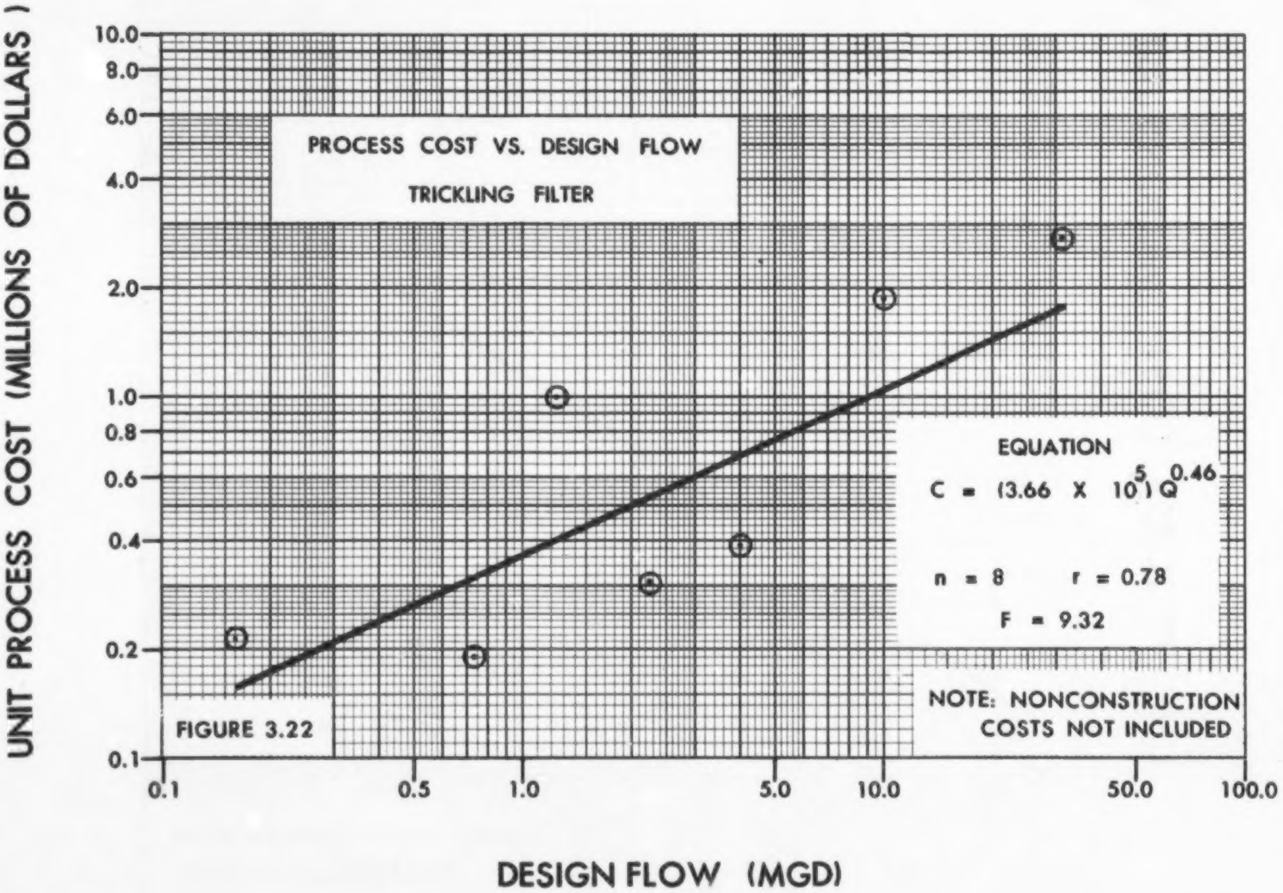
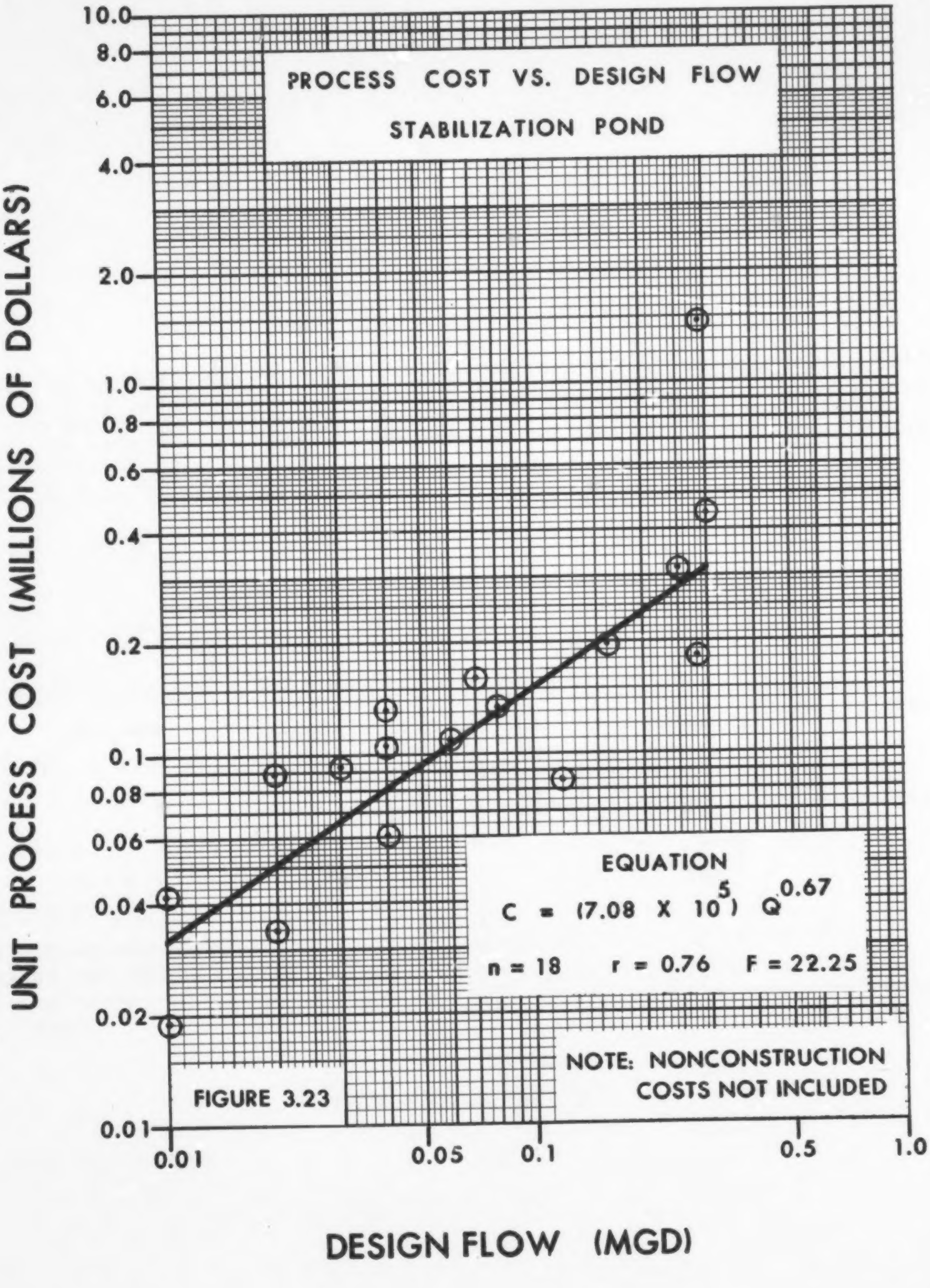

PROCESS COST VS. DESIGN FLOW
TRICKLING FILTER
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)
EQUATION
C = (3.66 X 10^5) Q^0.46
n = 8
r = 0.78
F = 9.32
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.22



PROCESS COST VS. DESIGN FLOW

STABILIZATION POND

EQUATION

$C = (7.08 \times 10^5) Q^{0.67}$

n = 18 r = 0.76 F = 22.25

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.23

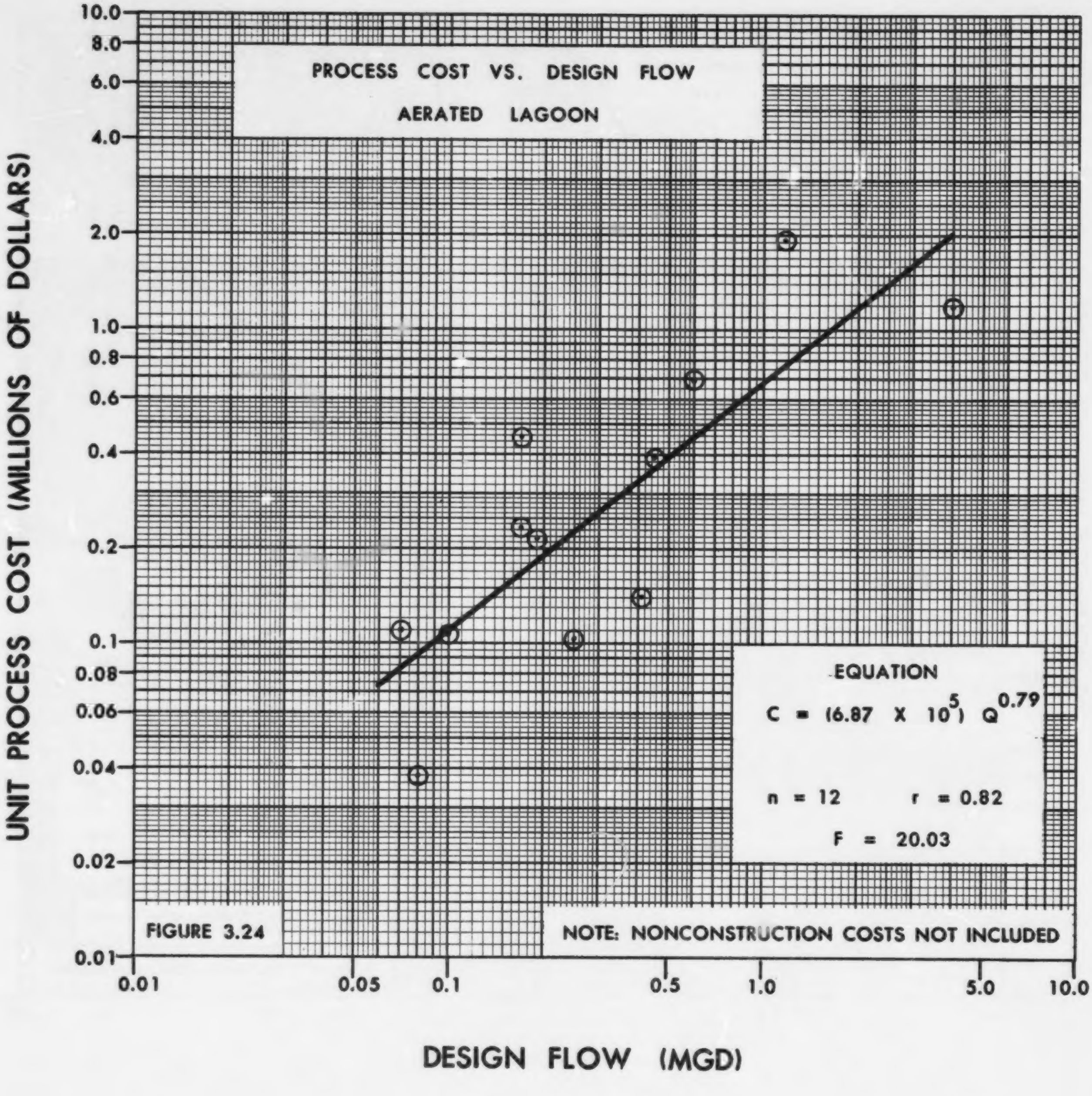

PROCESS COST VS. DESIGN FLOW
AERATED LAGOON
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.01
0.05
0.1
0.5
1.0
5.0
10.0
DESIGN FLOW (MGD)
EQUATION
$C = (6.87 \times 10^5) Q^{0.79}$
n = 12
r = 0.82
F = 20.03
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.24

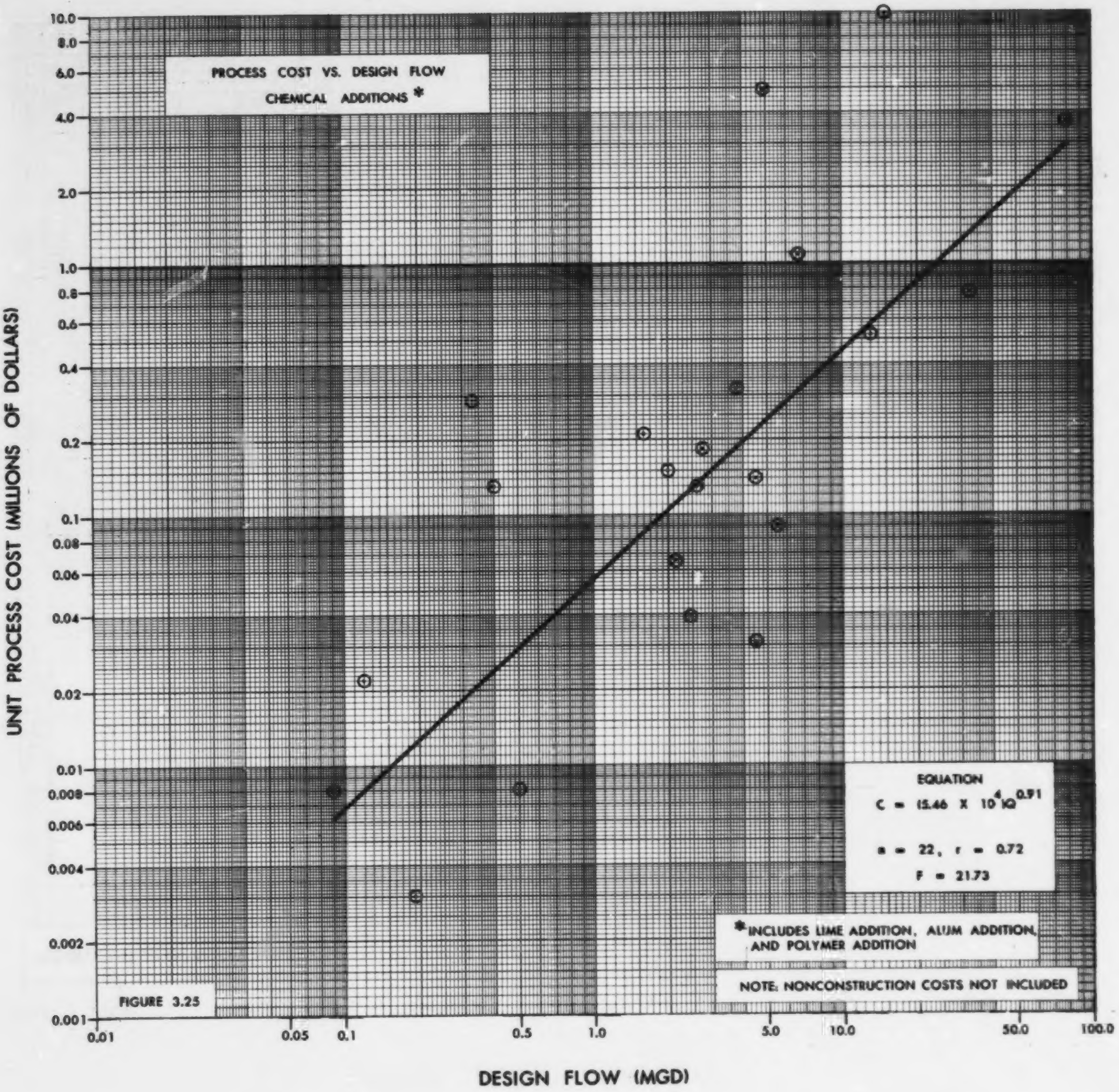
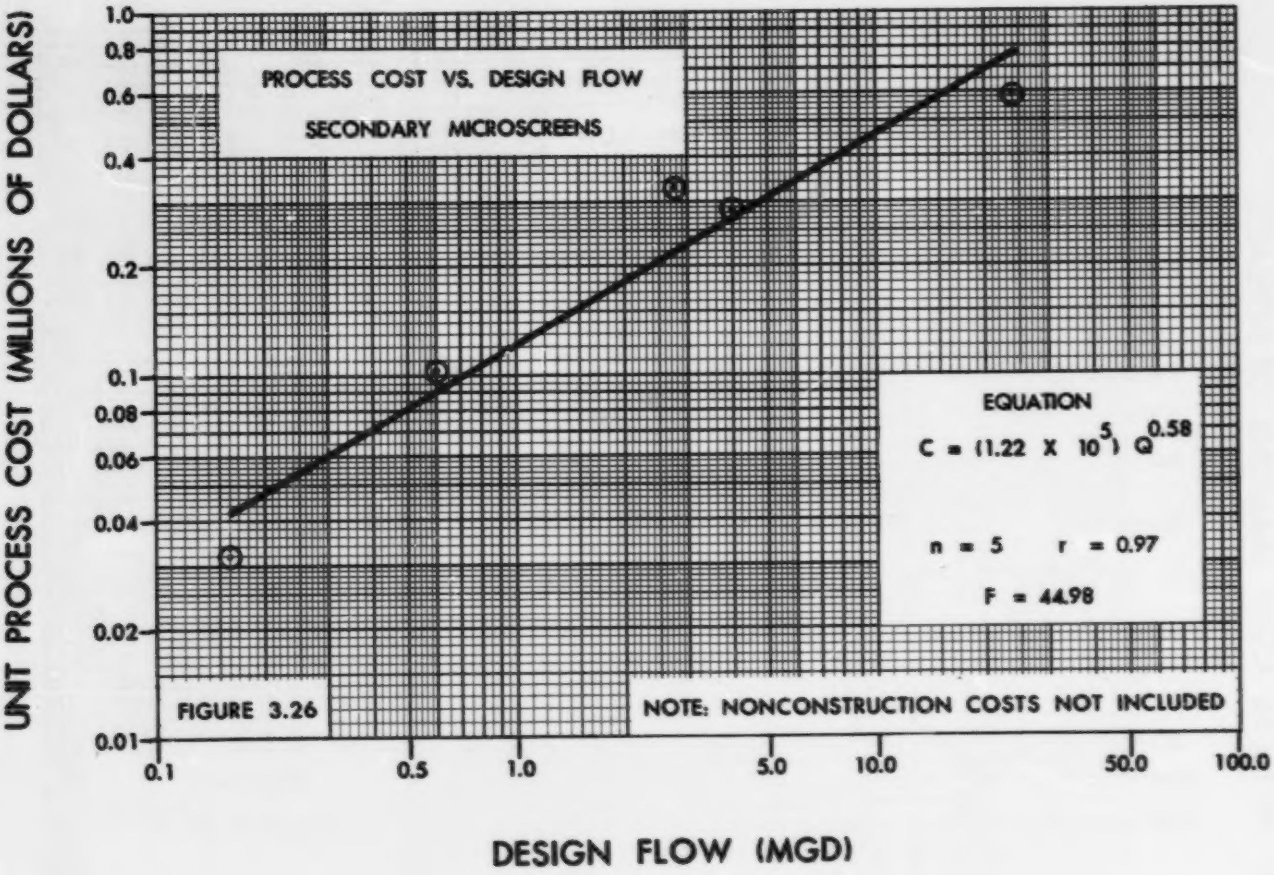

PROCESS COST VS. DESIGN FLOW
CHEMICAL ADDITIONS *
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)
EQUATION
C = 15.46 X 10^4 (Q)^0.91
n = 22, r = 0.72
F = 21.73
*INCLUDES LIME ADDITION, ALUM ADDITION, AND POLYMER ADDITION
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.25


PROCESS COST VS. DESIGN FLOW
SECONDARY MICROSCREENS
EQUATION
$C = (1.22 \times 10^5)\,Q^{0.58}$
n = 5 r = 0.97
F = 44.98
FIGURE 3.26
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
UNIT PROCESS COST (MILLIONS OF DOLLARS)
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

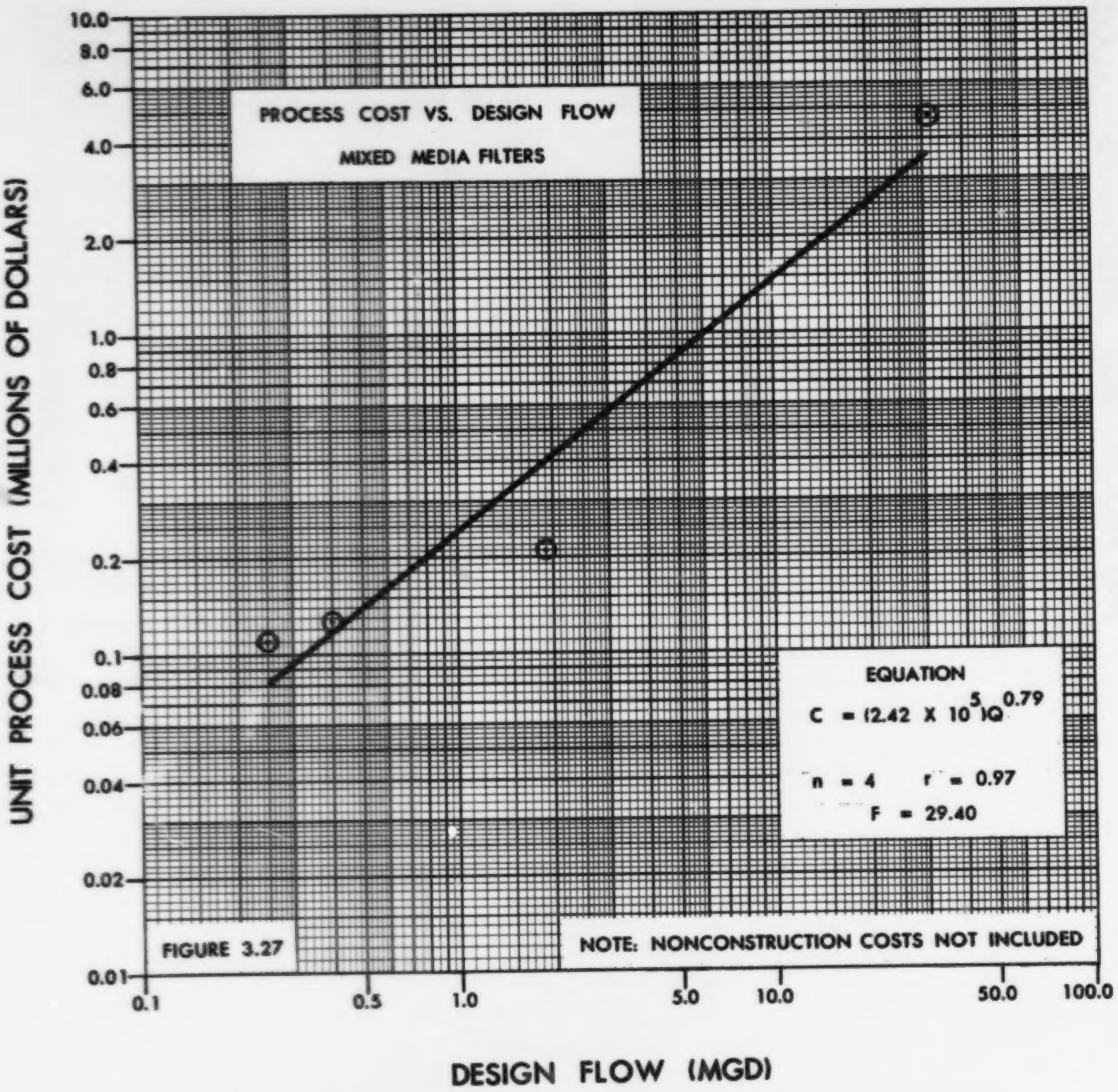

PROCESS COST VS. DESIGN FLOW
MIXED MEDIA FILTERS
EQUATION
C = (2.42 X 10^5)Q^0.79
n = 4 r² = 0.97
F = 29.40
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.27

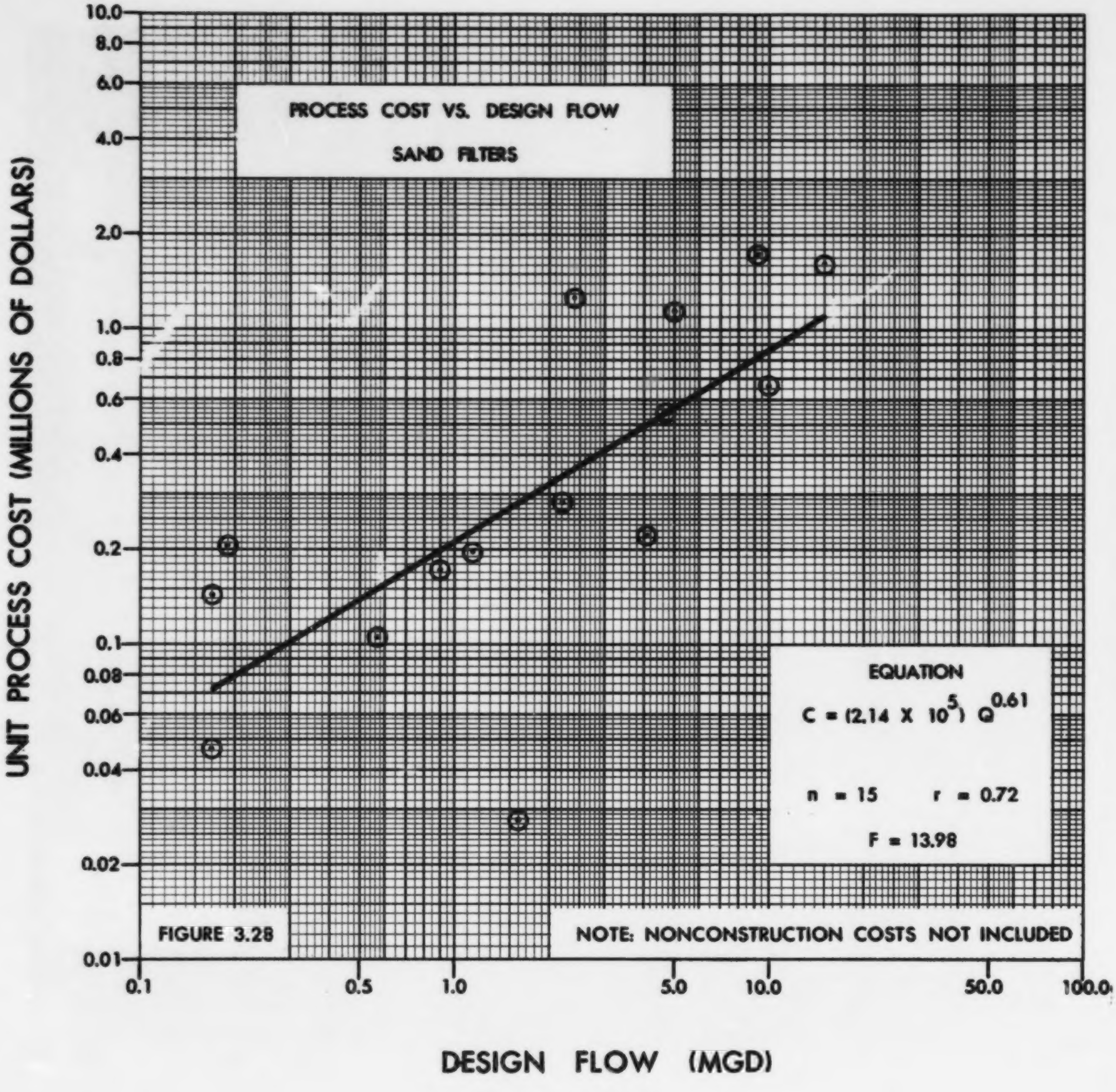

PROCESS COST VS. DESIGN FLOW
SAND FILTERS
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)
EQUATION
C = (2.14 X 10^5) Q^0.61
n = 15
r = 0.72
F = 13.98
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.28

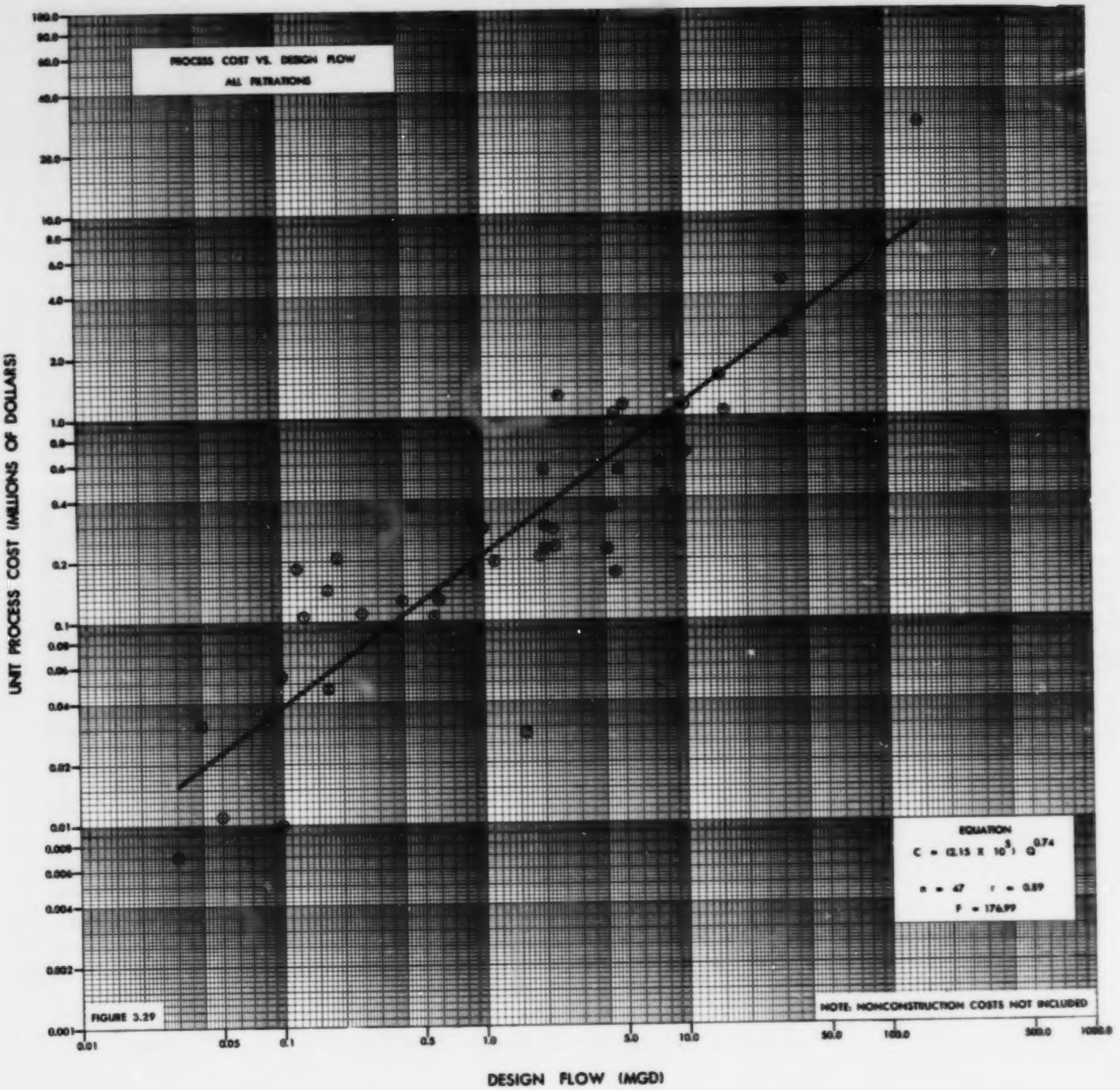

PROCESS COST VS. DESIGN FLOW
ALL FILTRATIONS
UNIT PROCESS COST (MILLIONS OF DOLLARS)
100.0
80.0
60.0
40.0
20.0
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
500.0
1000.0
DESIGN FLOW (MGD)
EQUATION
C = (2.15 X 10^5) Q^0.74
n = 47 r = 0.89
F = 176.99
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.29

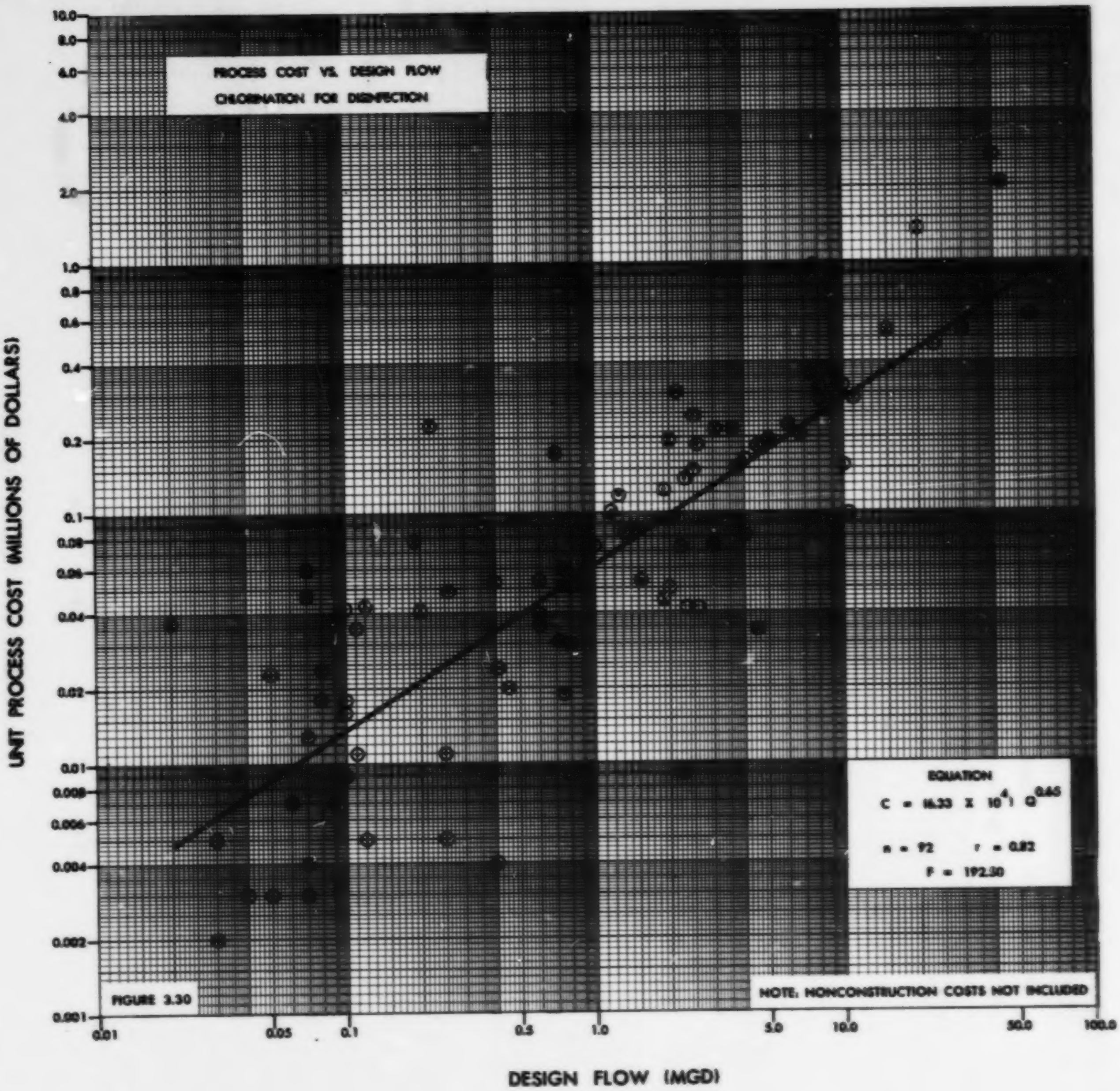
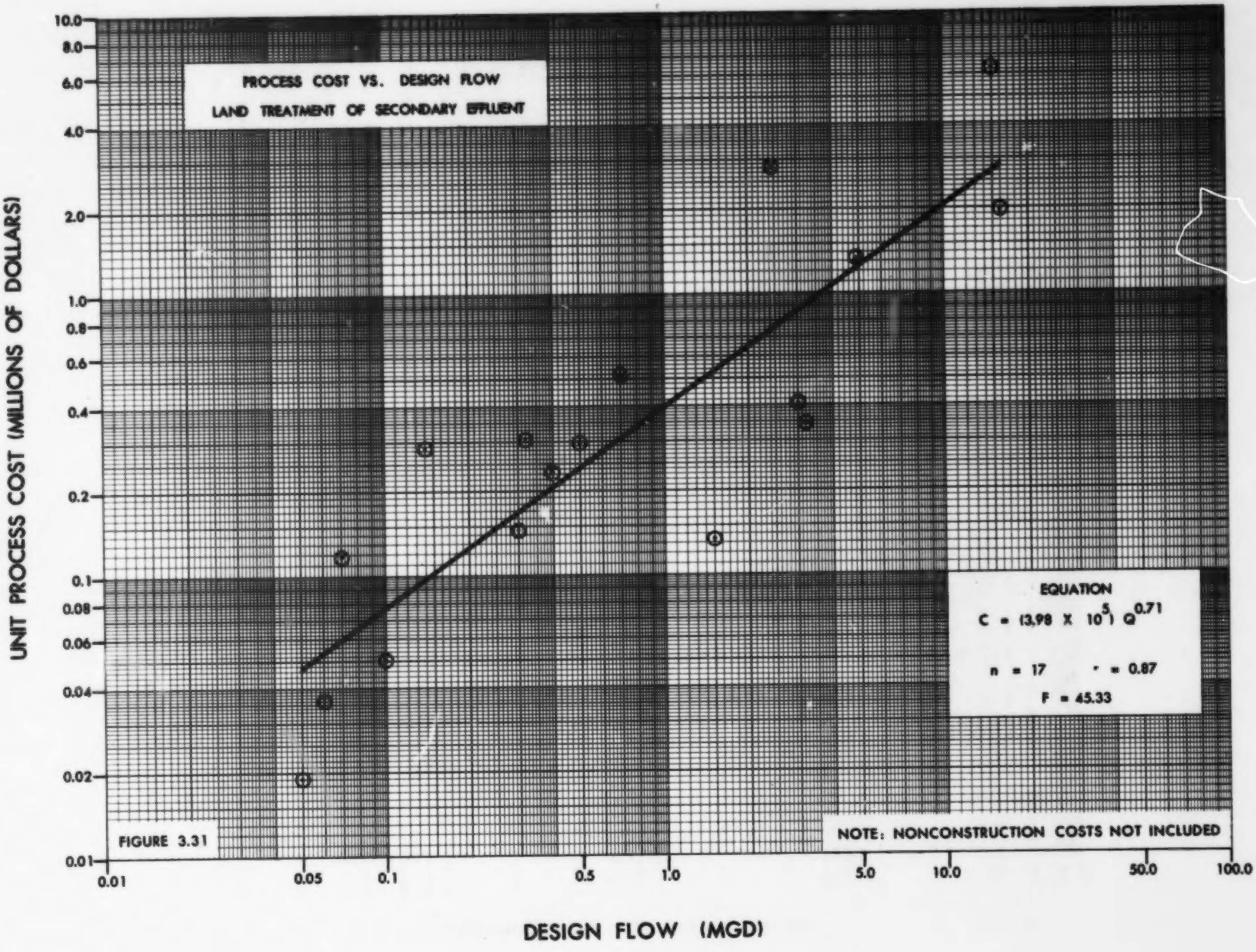

PROCESS COST VS. DESIGN FLOW
CHLORINATION FOR DISINFECTION
UNIT PROCESS COST (MILLIONS OF DOLLARS)
DESIGN FLOW (MGD)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
EQUATION
C = (16.33 X 10^4) Q^0.65
n = 92
r = 0.82
F = 192.30
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.30



PROCESS COST VS. DESIGN FLOW
LAND TREATMENT OF SECONDARY EFFLUENT

FIGURE 3.31

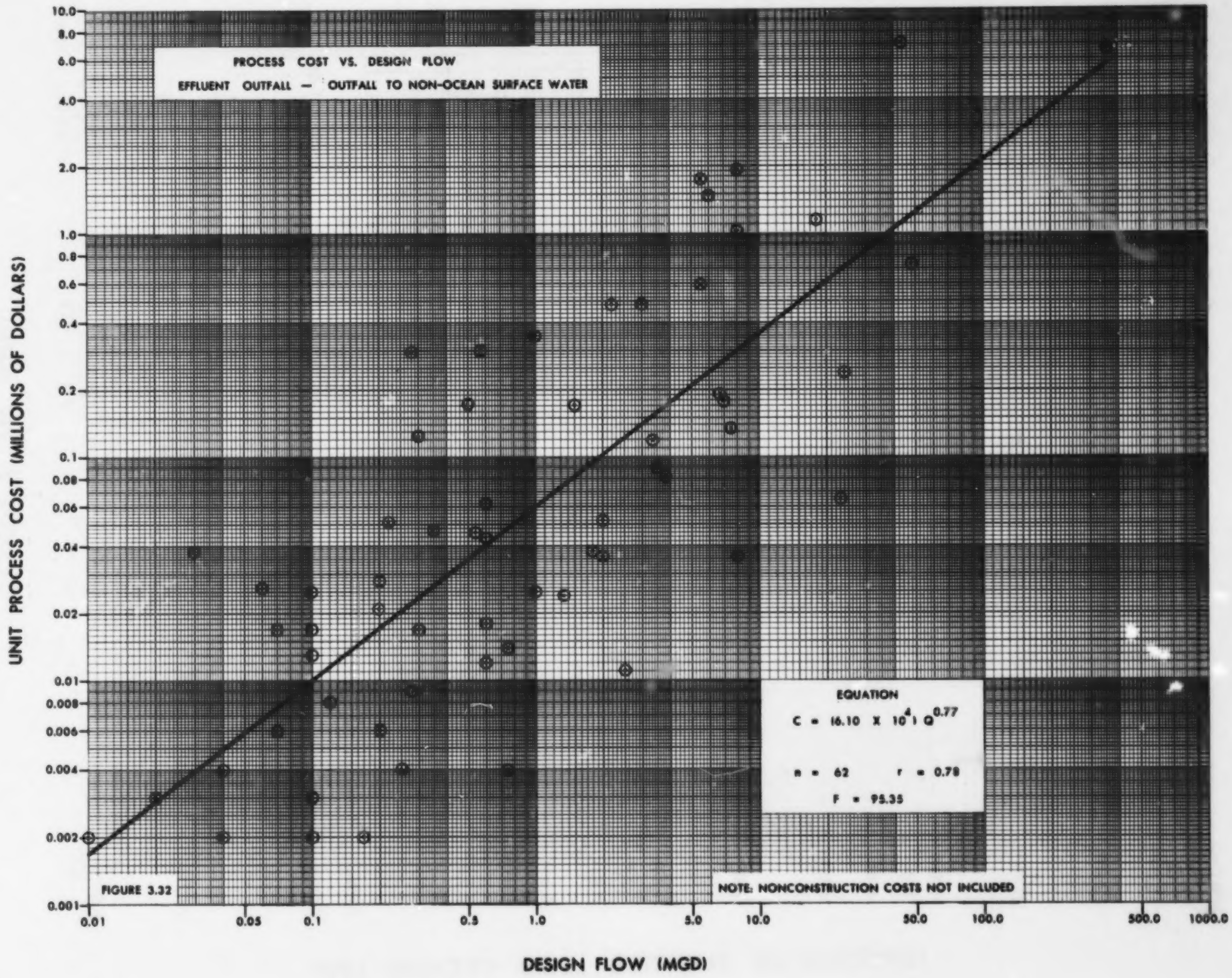
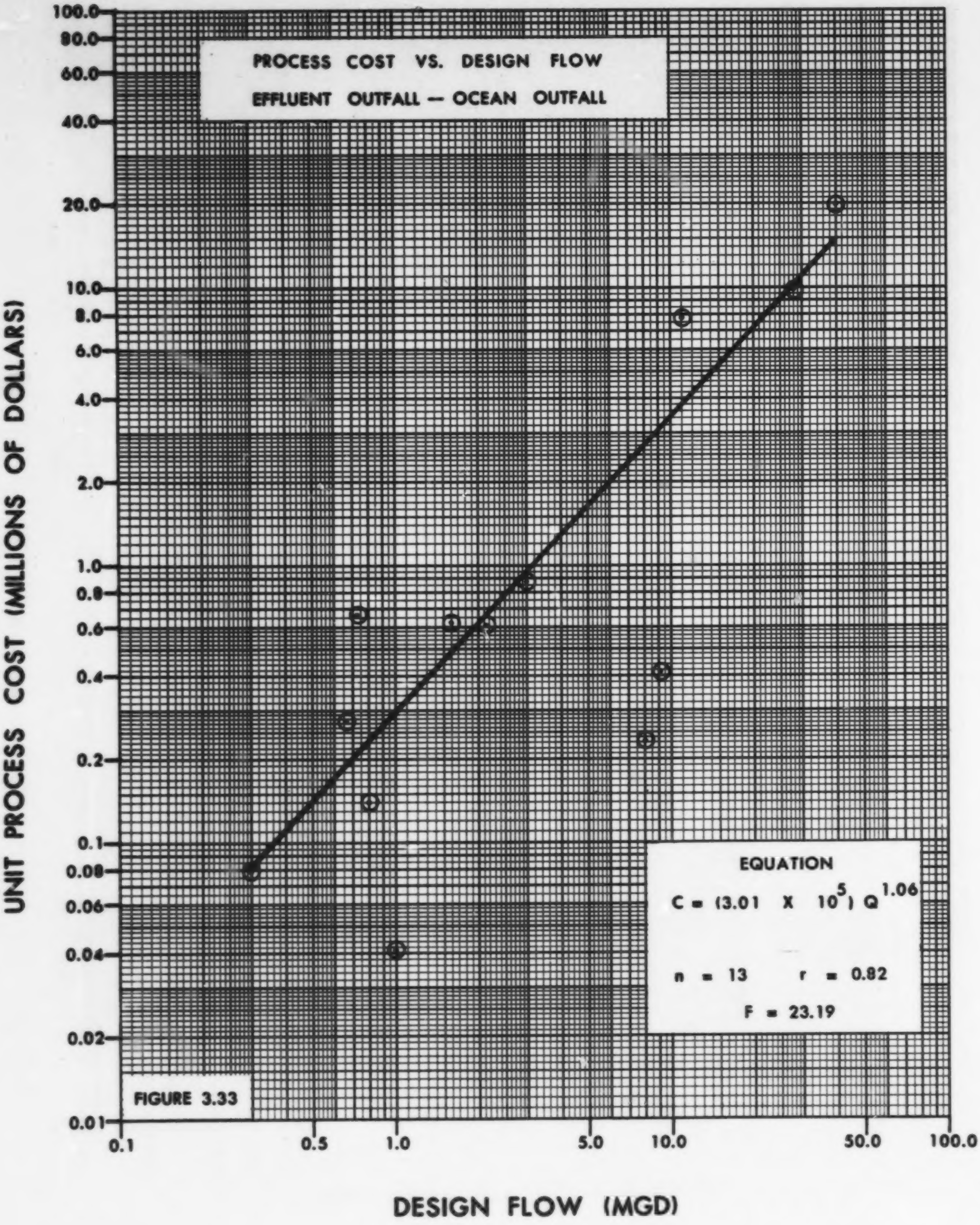

PROCESS COST VS. DESIGN FLOW
EFFLUENT OUTFALL — OUTFALL TO NON-OCEAN SURFACE WATER
EQUATION
C = 16.10 X 10^4 1 Q^0.77
n = 62
r = 0.78
F = 95.35
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
DESIGN FLOW (MGD)
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
500.0
1000.0

FIGURE 3.32



$$C = (3.01 \times 10^5)\, Q^{1.06}$$

$n = 13$ $r = 0.82$

$F = 23.19$

FIGURE 3.33

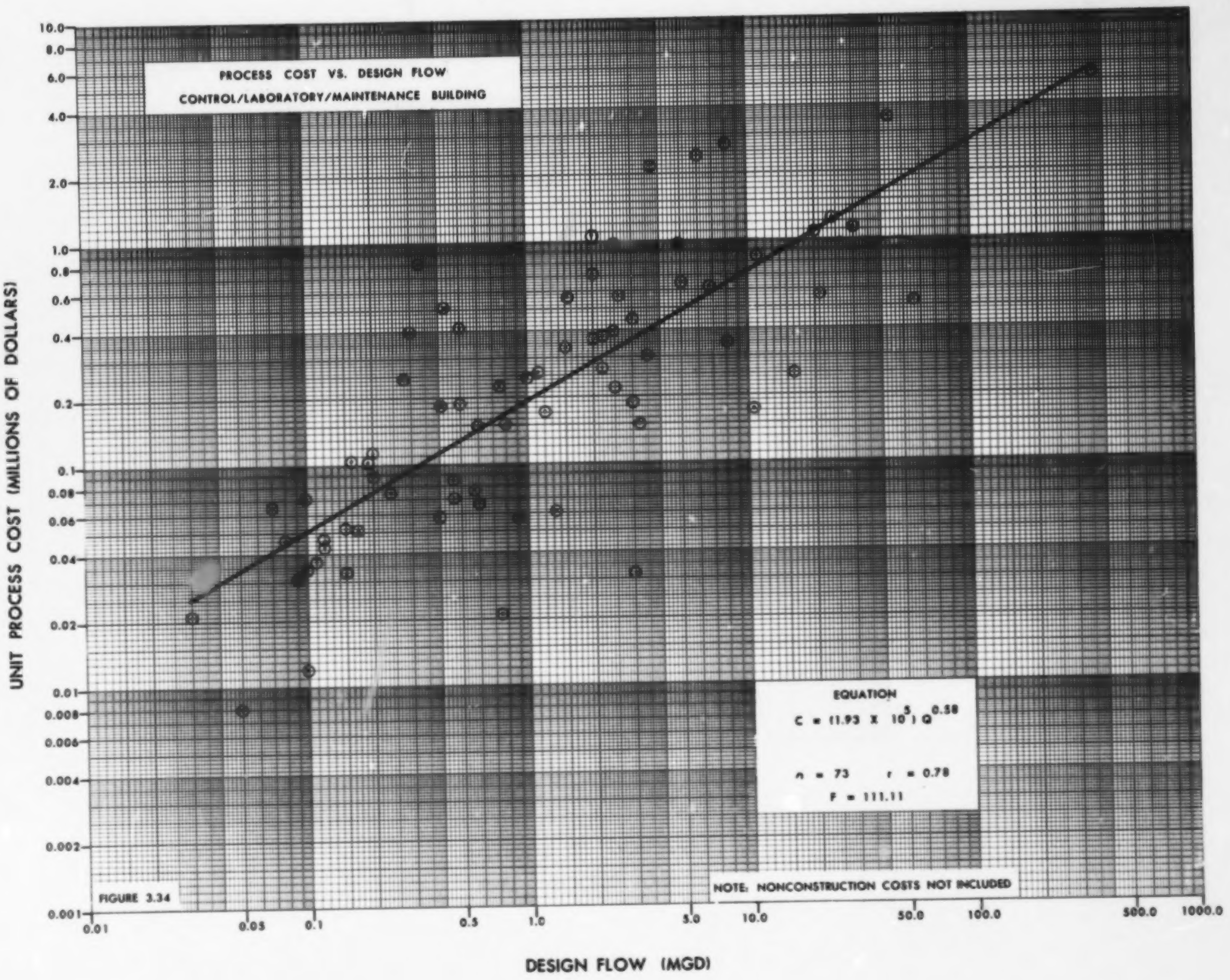


FIGURE 3.34

PROCESS COST VS. DESIGN FLOW

CONTROL/LABORATORY/MAINTENANCE BUILDING

EQUATION

$C = (1.93 \times 10^5) Q^{0.58}$

$n = 73$ $r = 0.78$

$F = 111.11$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

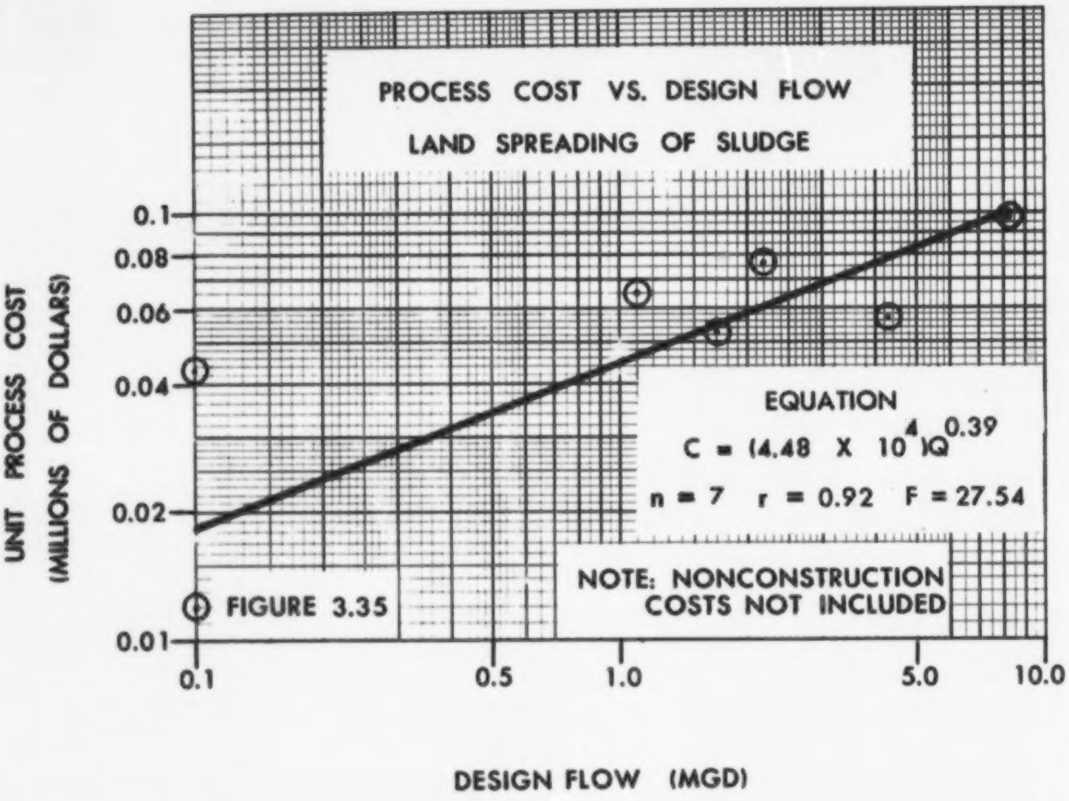


FIGURE 3.35

PROCESS COST VS. DESIGN FLOW
LAND SPREADING OF SLUDGE

EQUATION

$C = (4.48 \times 10^4)Q^{0.39}$

$n = 7 \quad r = 0.92 \quad F = 27.54$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

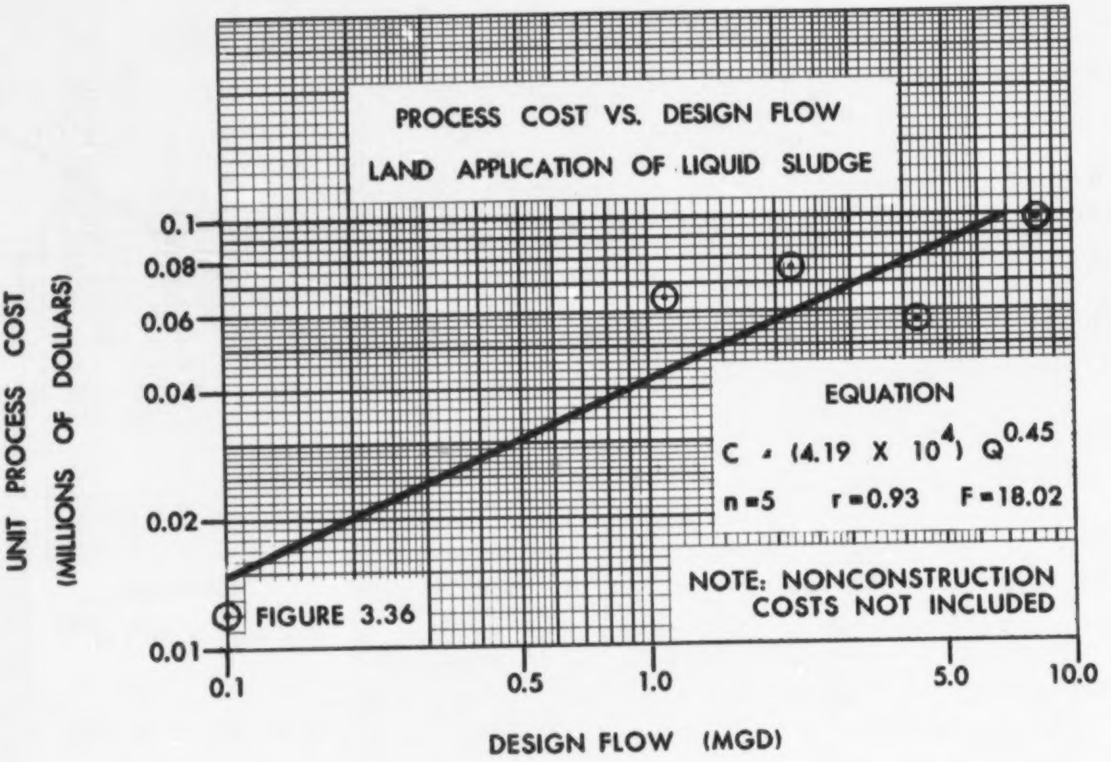

PROCESS COST VS. DESIGN FLOW
LAND APPLICATION OF LIQUID SLUDGE
UNIT PROCESS COST
(MILLIONS OF DOLLARS)
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
DESIGN FLOW (MGD)
EQUATION
C = (4.19 X 10^4) Q^0.45
n = 5 r = 0.93 F = 18.02
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.36

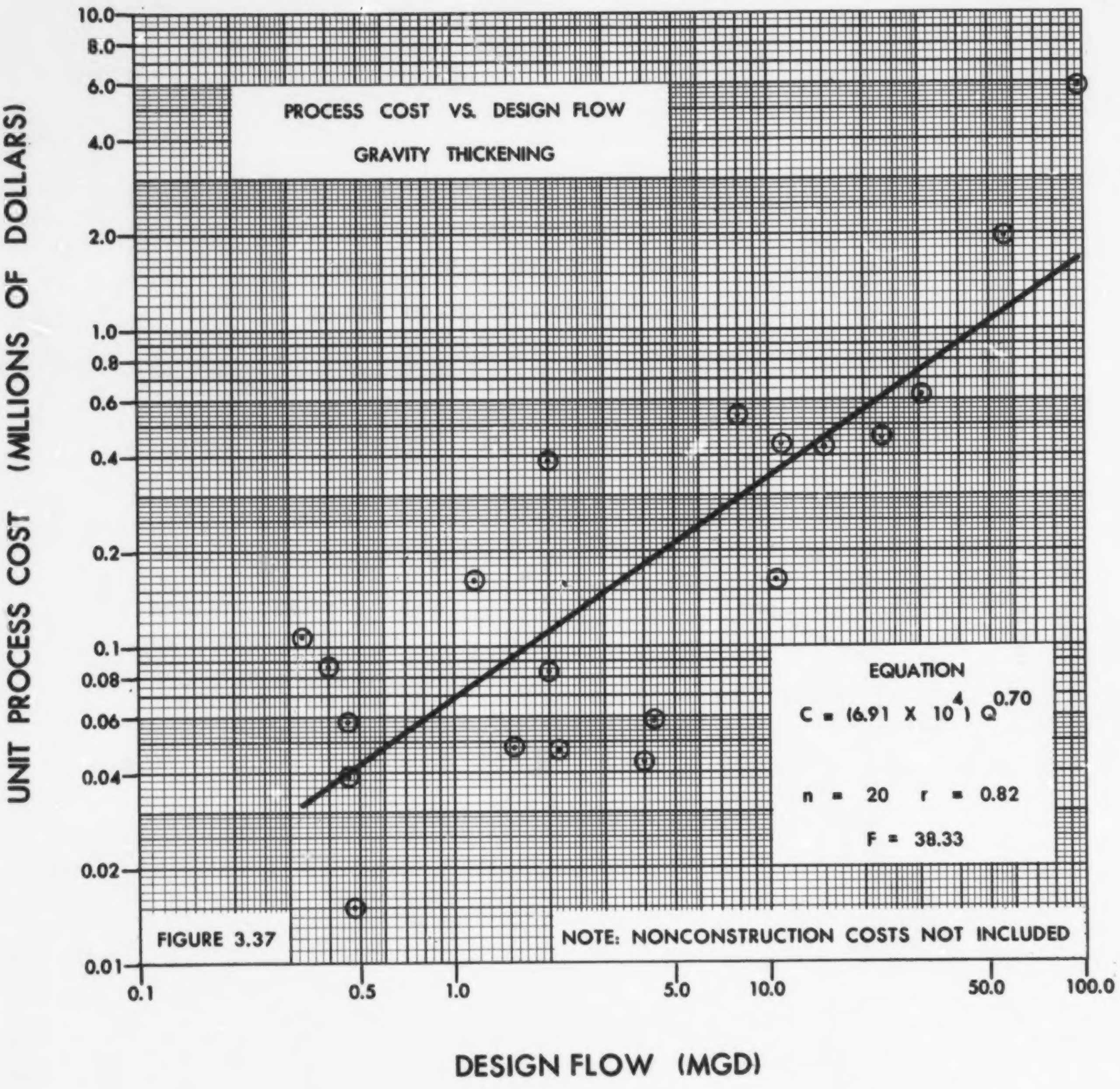


FIGURE 3.37

PROCESS COST VS. DESIGN FLOW

GRAVITY THICKENING

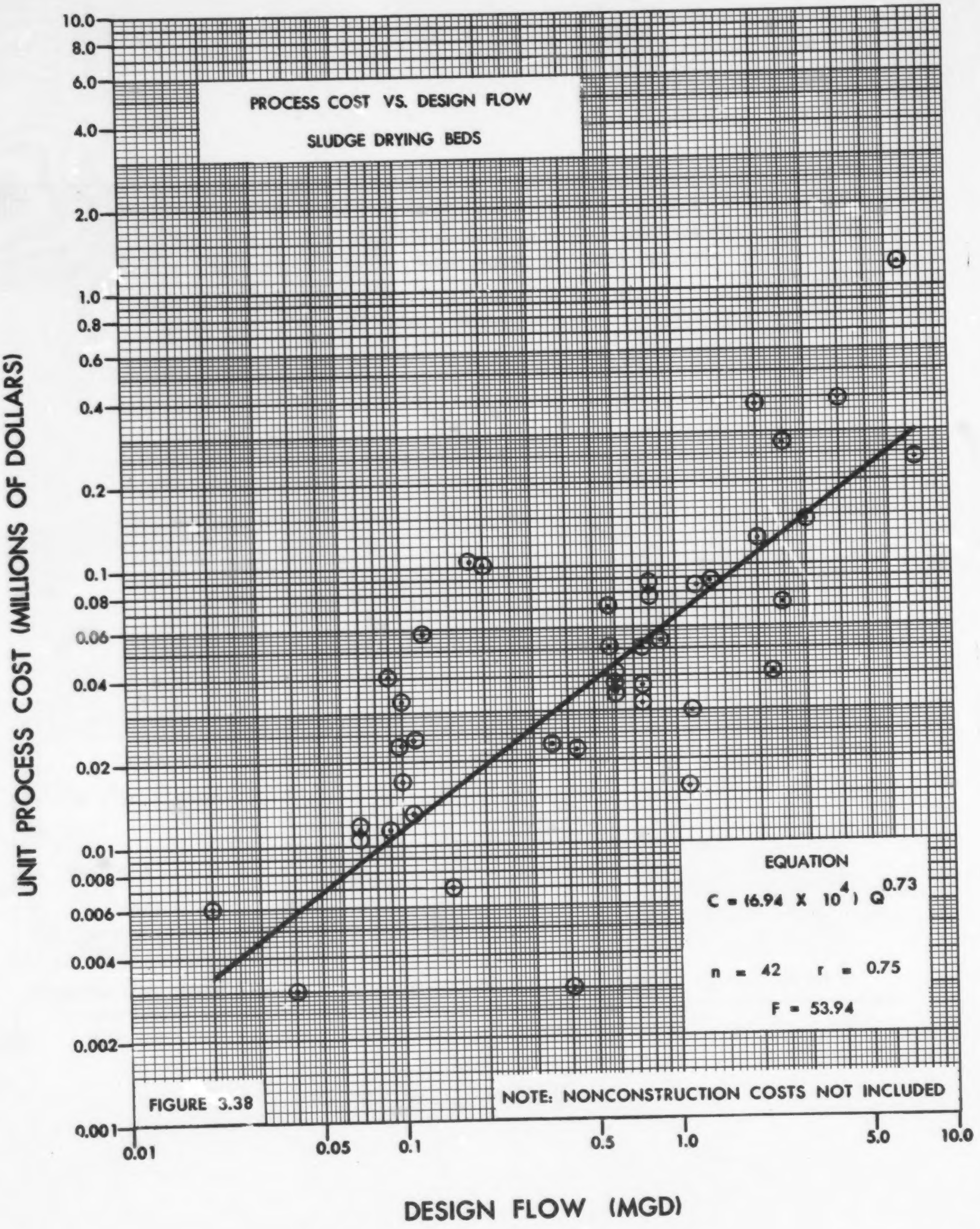
EQUATION

$C = (6.91 \times 10^4)\,Q^{0.70}$

$n = 20 \quad r = 0.82$

$F = 38.33$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



PROCESS COST VS. DESIGN FLOW

SLUDGE DRYING BEDS

EQUATION

$C = (6.94 \times 10^4)\ Q^{0.73}$

n = 42 r = 0.75

F = 53.94

FIGURE 3.38

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

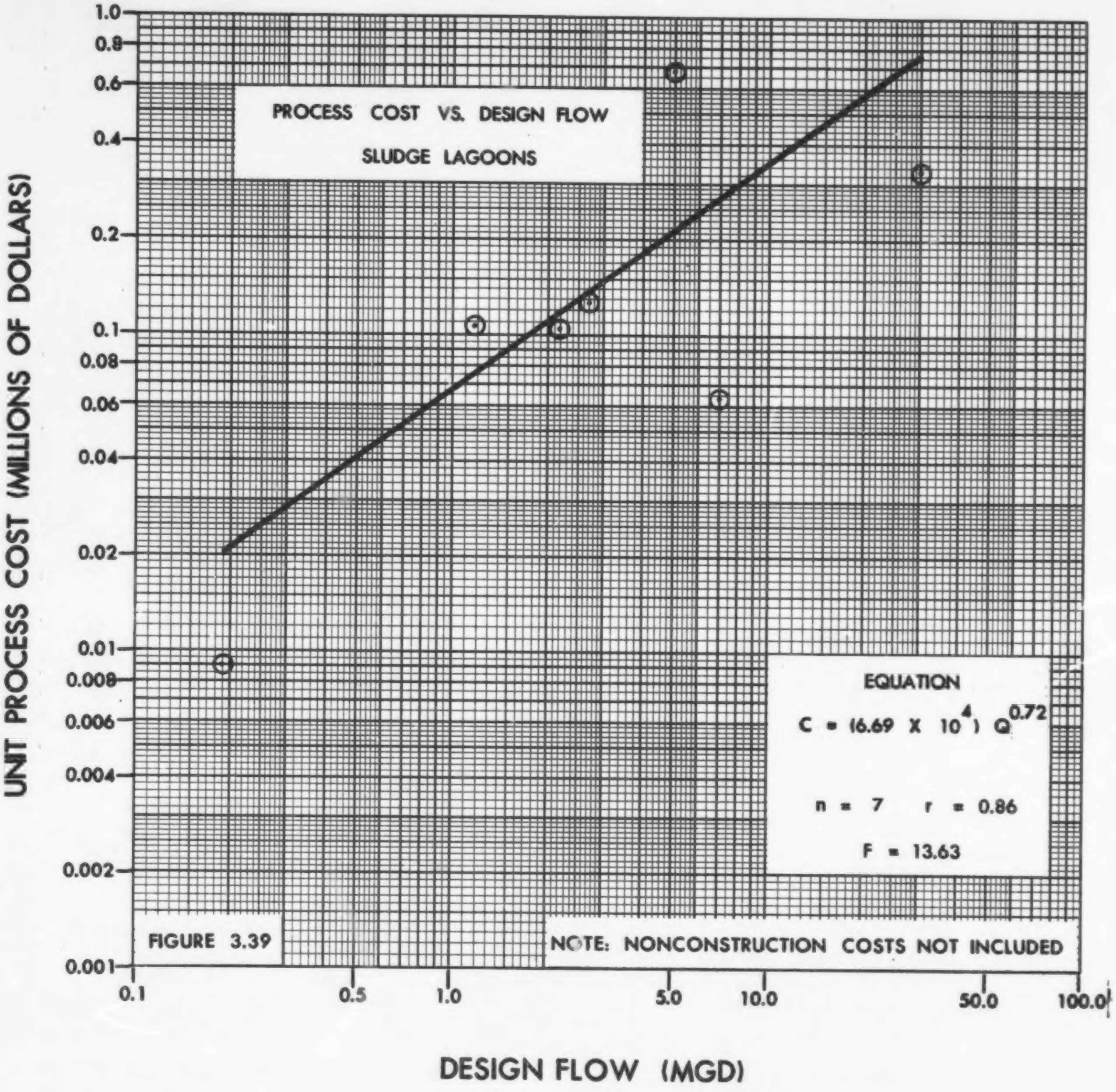


FIGURE 3.39

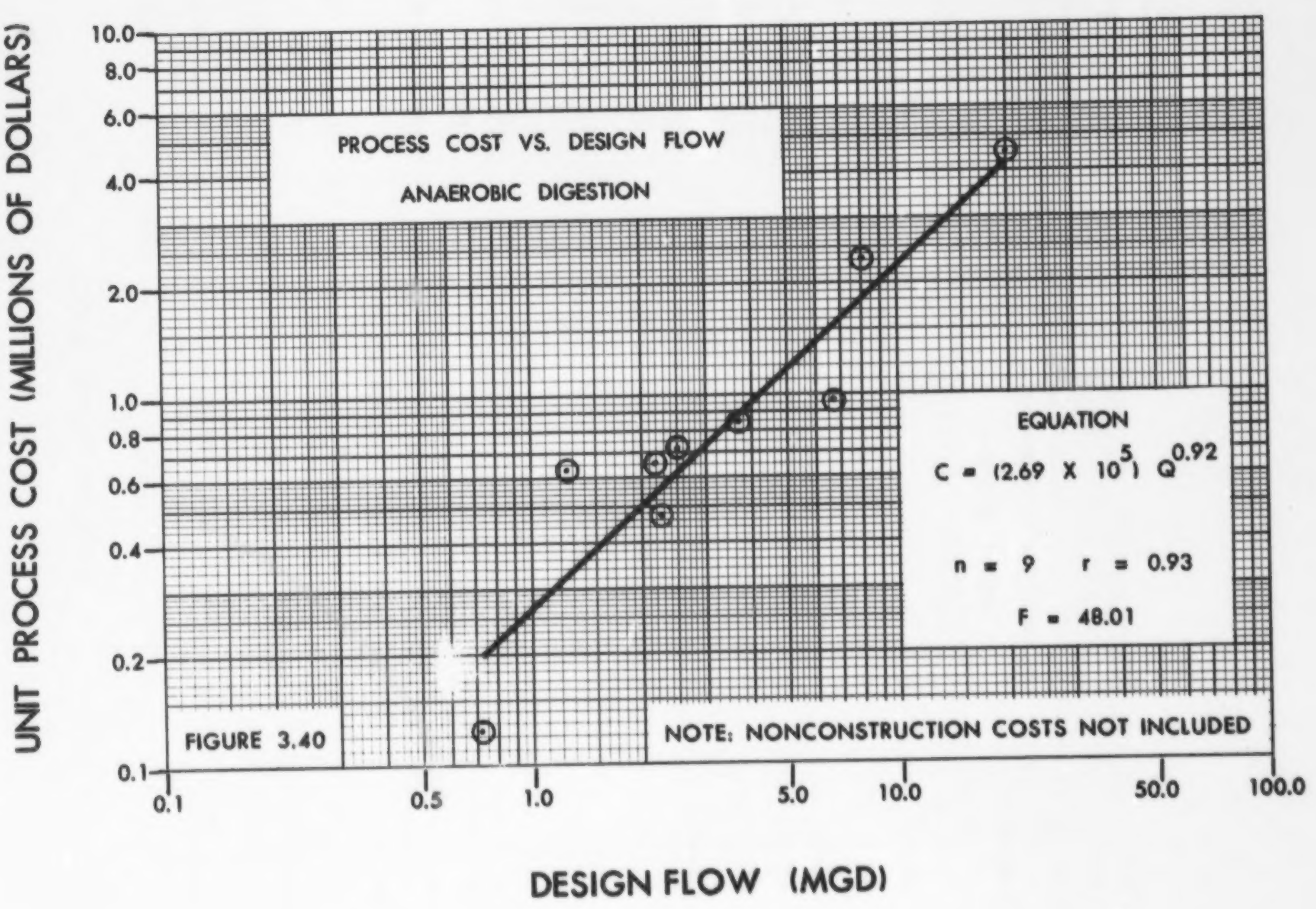
EQUATION

$C = (6.69 \times 10^4)\,Q^{0.72}$

$n = 7 \quad r = 0.86$

$F = 13.63$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED



PROCESS COST VS. DESIGN FLOW
ANAEROBIC DIGESTION

EQUATION

$C = (2.69 \times 10^5)\ Q^{0.92}$

$n = 9 \quad r = 0.93$

$F = 48.01$

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.40

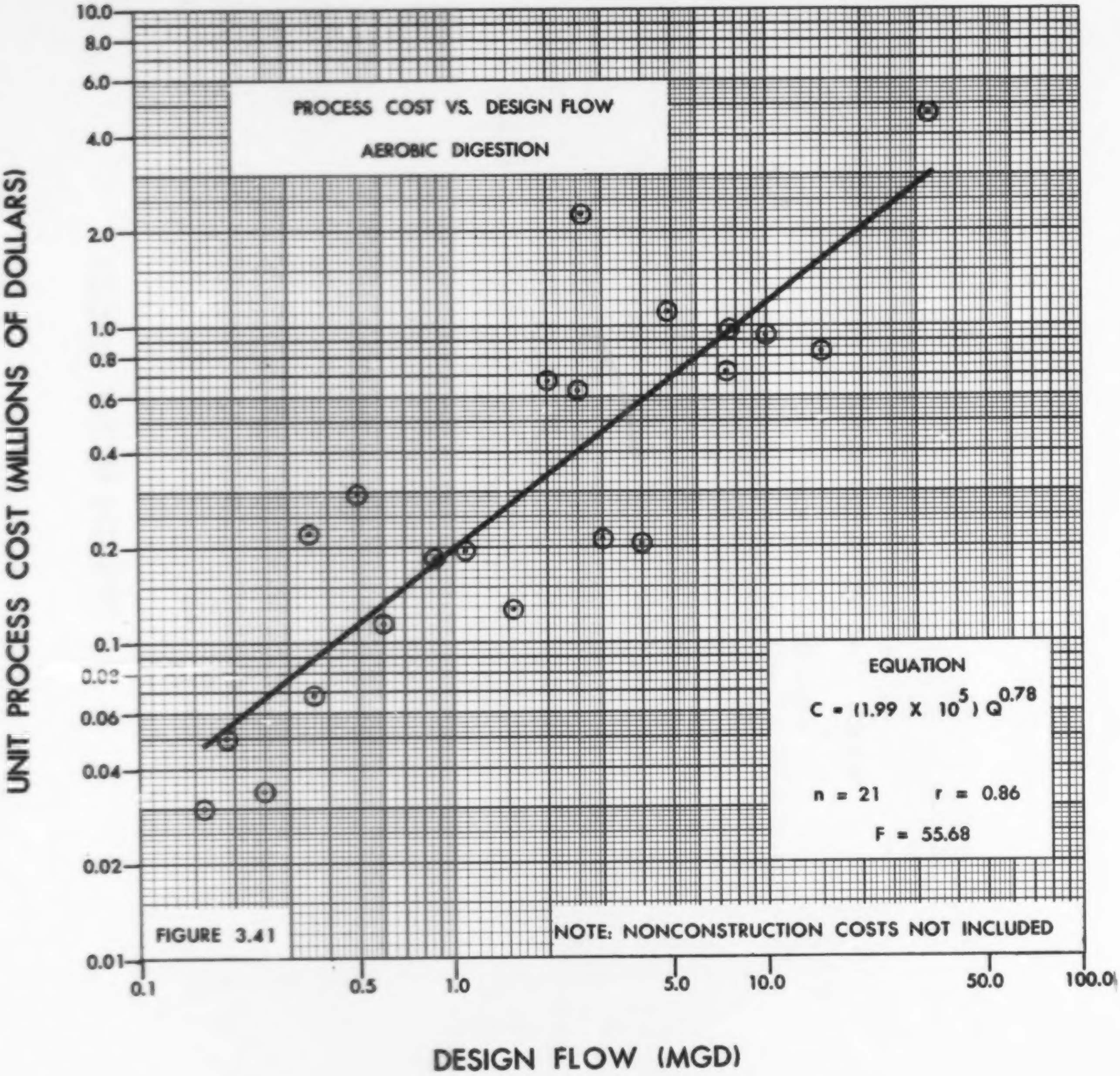

PROCESS COST VS. DESIGN FLOW
AEROBIC DIGESTION
UNIT PROCESS COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)
EQUATION
$C = (1.99 \times 10^5) Q^{0.78}$
n = 21
r = 0.86
F = 55.68
NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

FIGURE 3.41

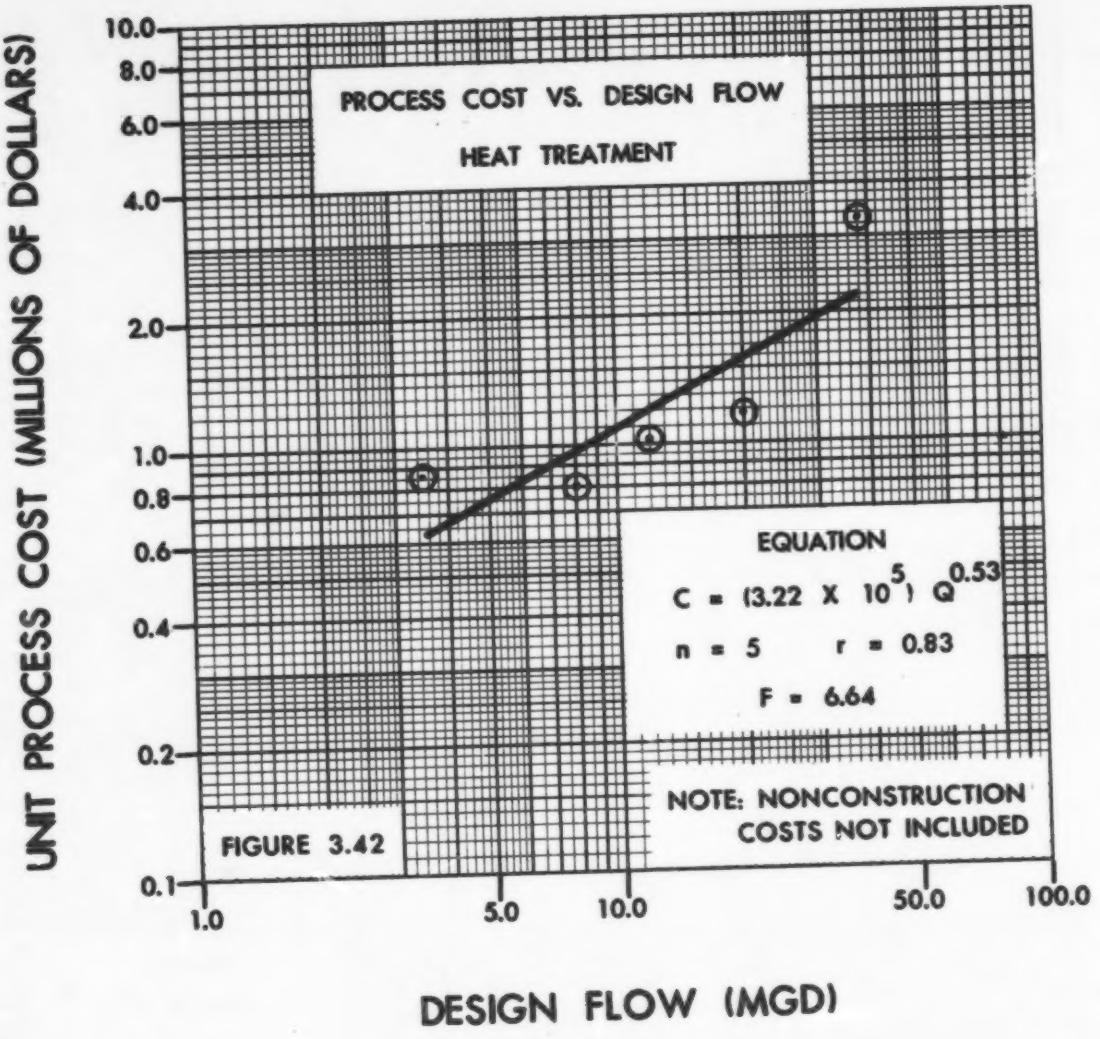
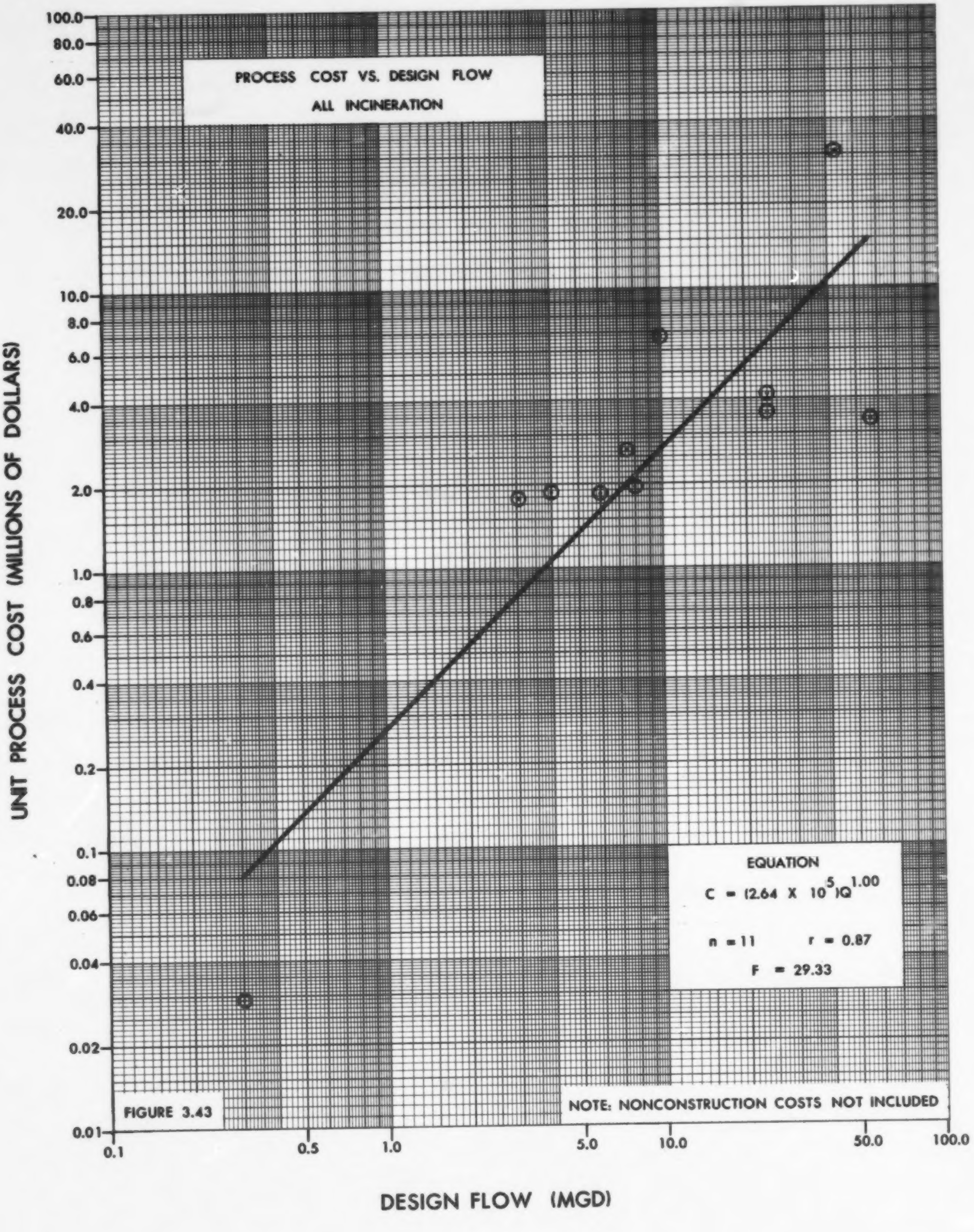


FIGURE 3.42

$C = (3.22 \times 10^{5})\,Q^{0.53}$

$n = 5 \quad r = 0.83$

$F = 6.64$



PROCESS COST VS. DESIGN FLOW

ALL INCINERATION

EQUATION

$C = (2.64 \times 10^5)Q^{1.00}$

$n = 11$ $r = 0.87$

$F = 29.33$

FIGURE 3.43

NOTE: NONCONSTRUCTION COSTS NOT INCLUDED

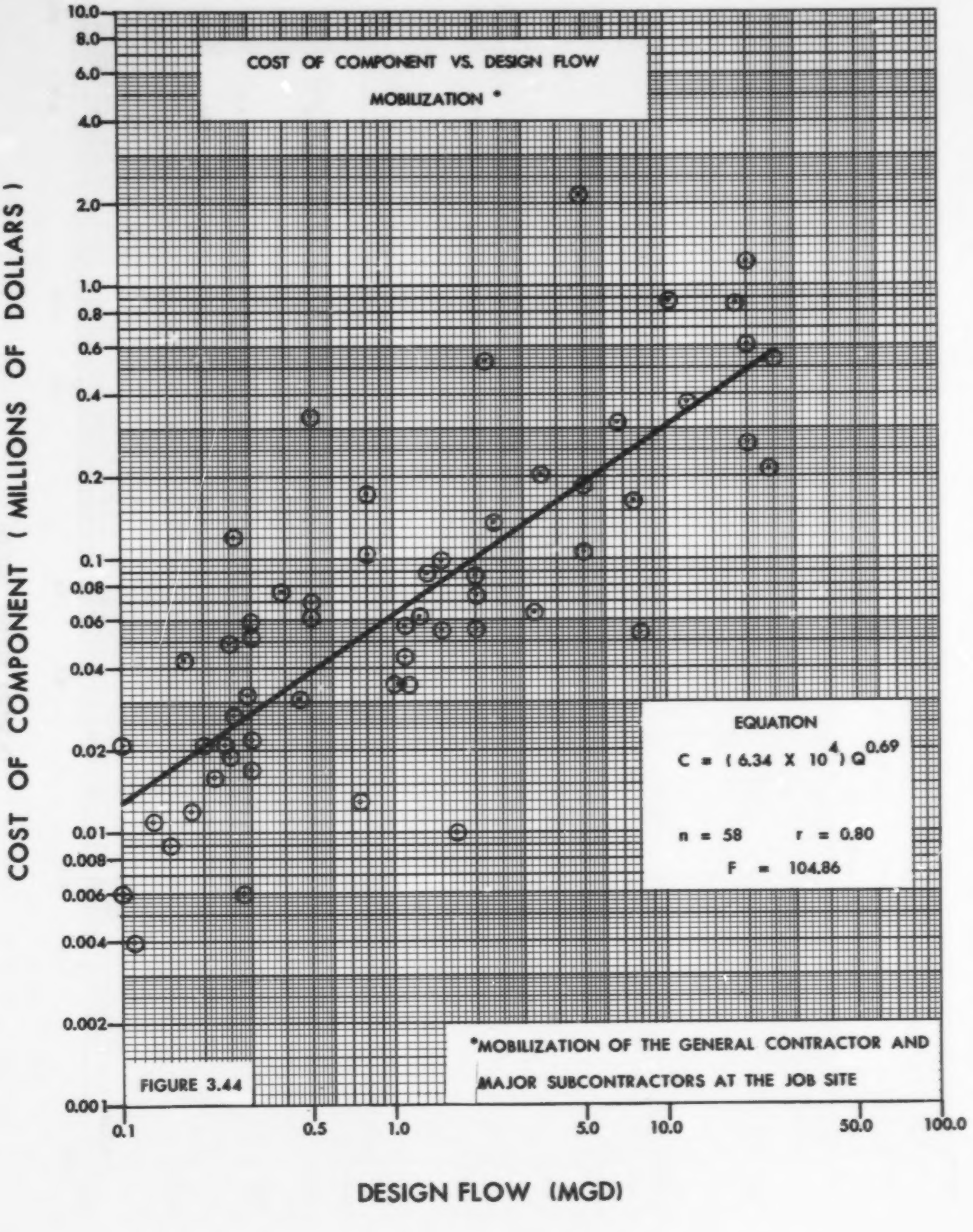


FIGURE 3.44

COST OF COMPONENT VS. DESIGN FLOW
MOBILIZATION *

*MOBILIZATION OF THE GENERAL CONTRACTOR AND MAJOR SUBCONTRACTORS AT THE JOB SITE

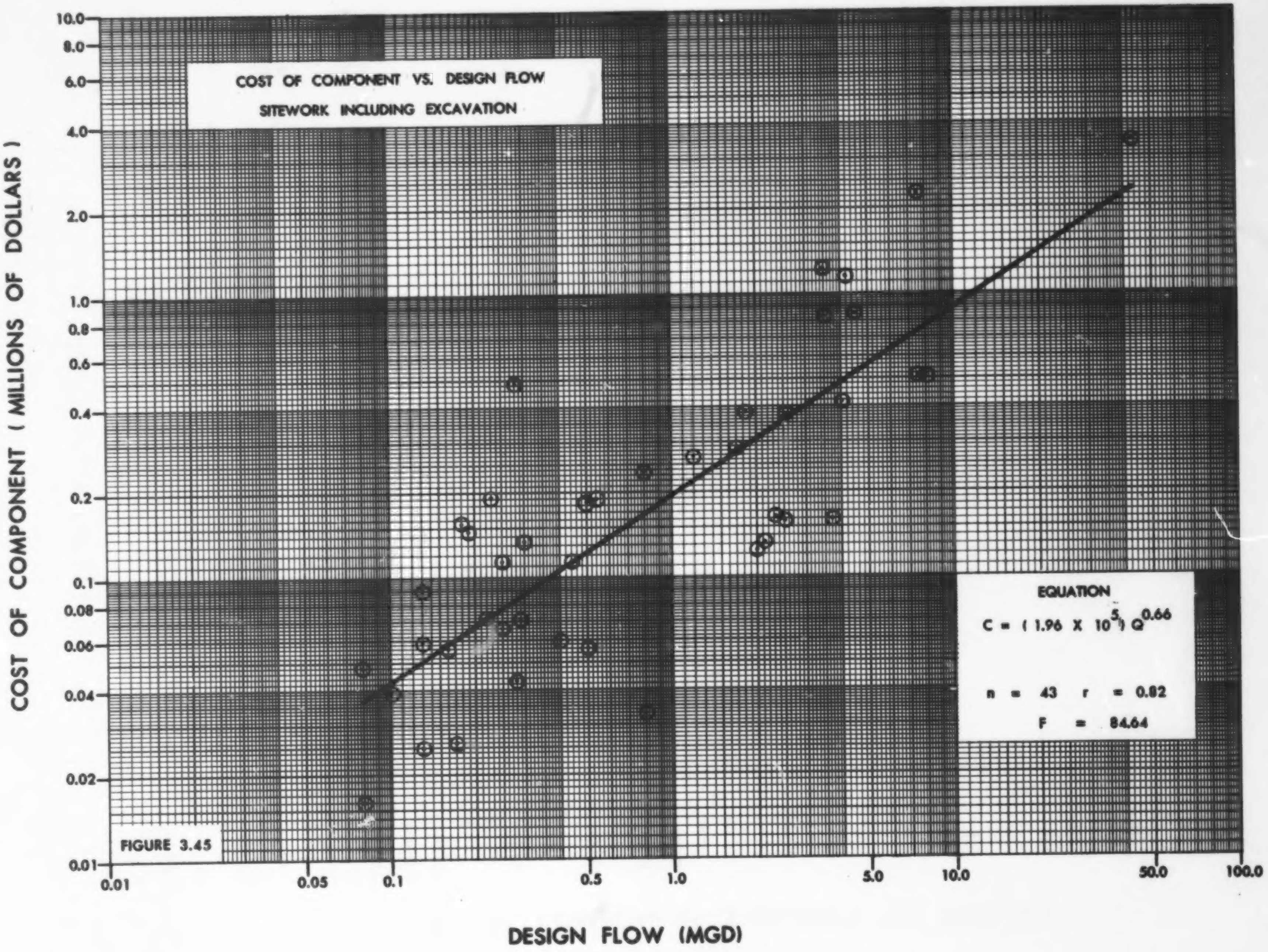


FIGURE 3.45

COST OF COMPONENT VS. DESIGN FLOW
SITEWORK INCLUDING EXCAVATION

EQUATION

$C = (1.96 \times 10^{5})\, Q^{0.66}$

$n = 43 \quad r = 0.82$

$F = 84.64$

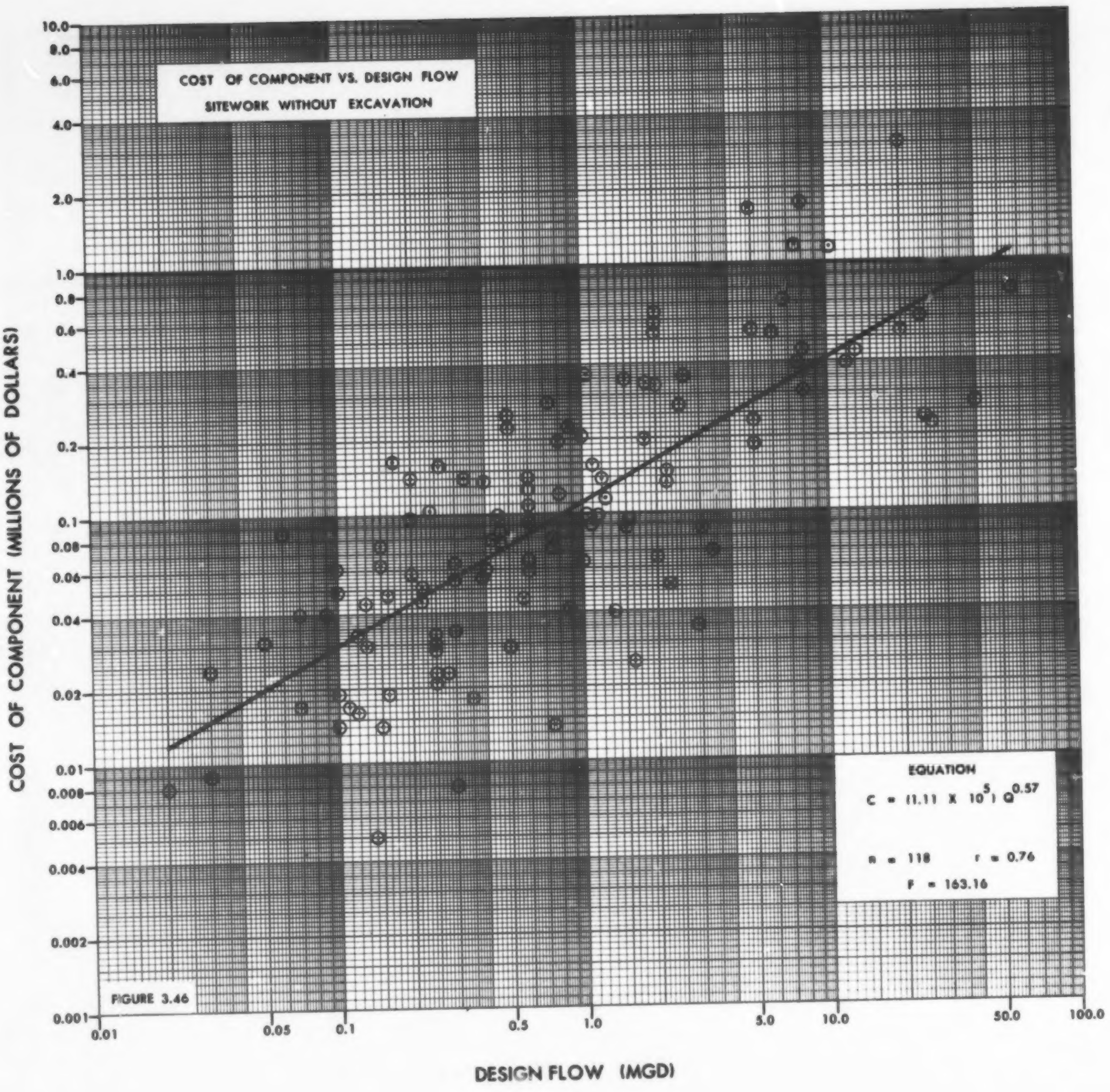
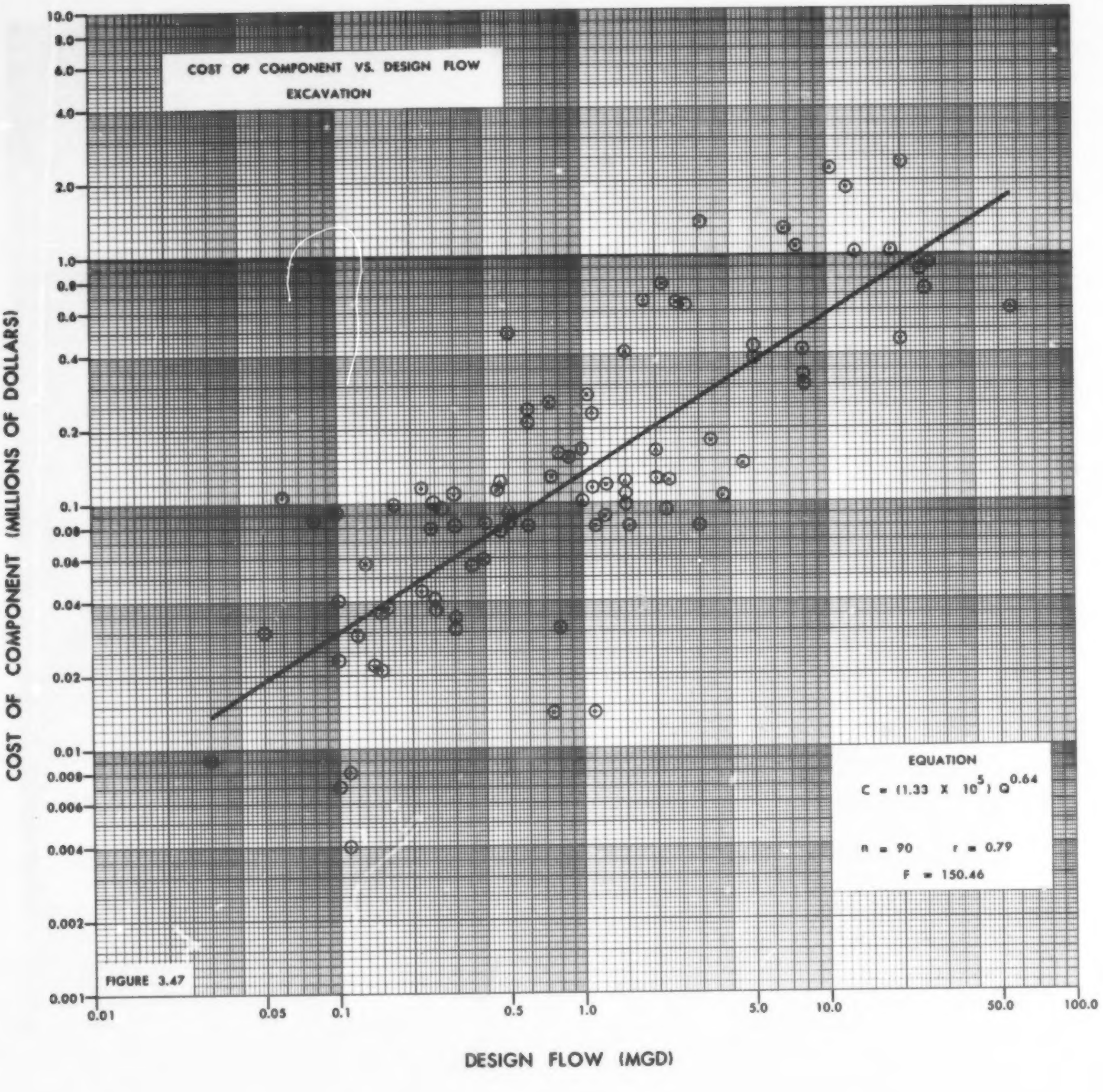
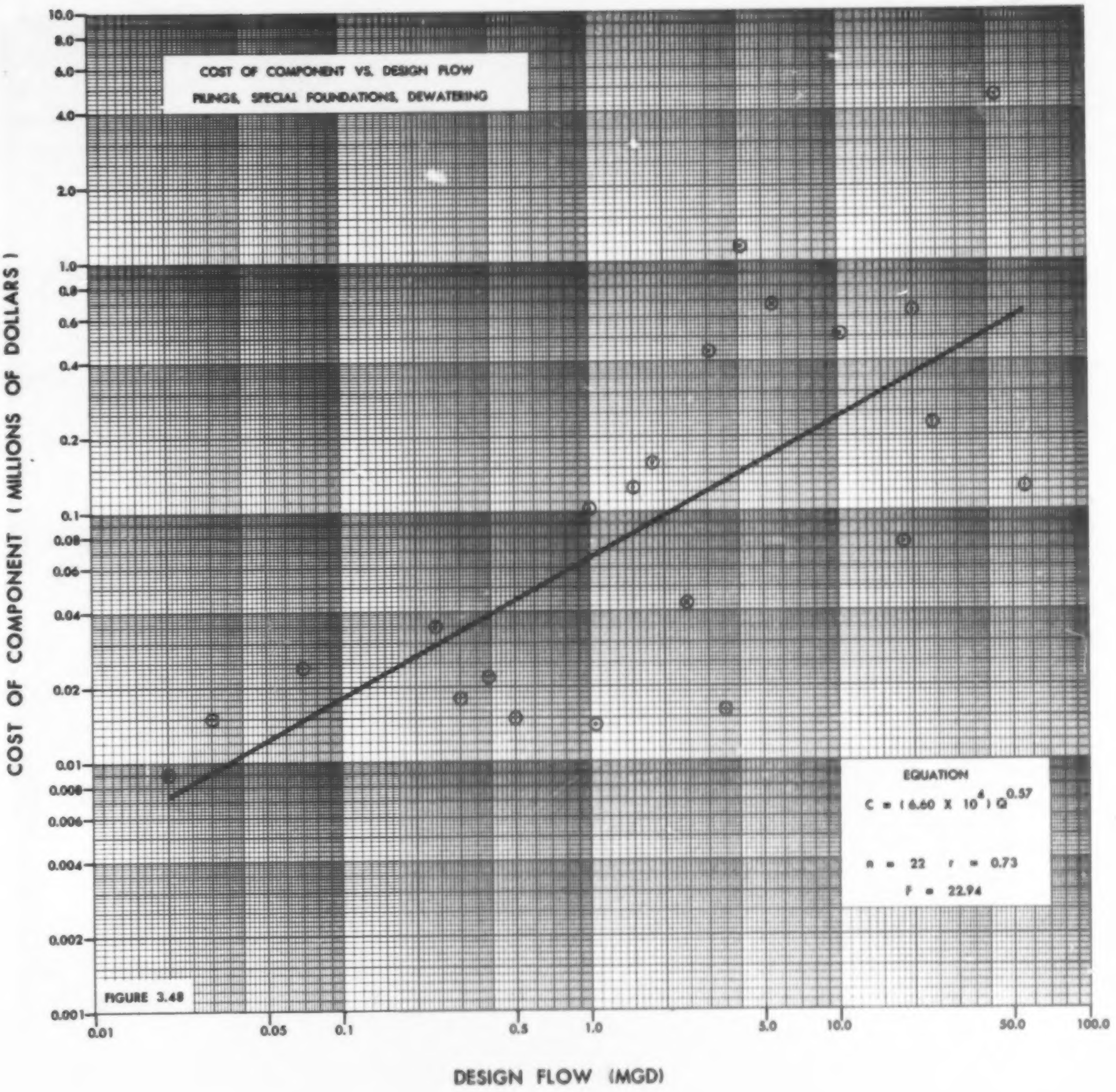

COST OF COMPONENT VS. DESIGN FLOW
SITEWORK WITHOUT EXCAVATION
EQUATION
C = (1.11 X 10^5) Q$^{0.57}$
n = 118
r = 0.76
F = 163.16
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.46


COST OF COMPONENT VS. DESIGN FLOW
EXCAVATION
EQUATION
$C = (1.33 \times 10^5)\ Q^{0.64}$
n = 90
r = 0.79
F = 150.46
FIGURE 3.47
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)


COST OF COMPONENT VS. DESIGN FLOW
PILINGS, SPECIAL FOUNDATIONS, DEWATERING
EQUATION
C = (6.60 X 10^4) Q^0.57
n = 22 r = 0.73
F = 22.94
FIGURE 3.48
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

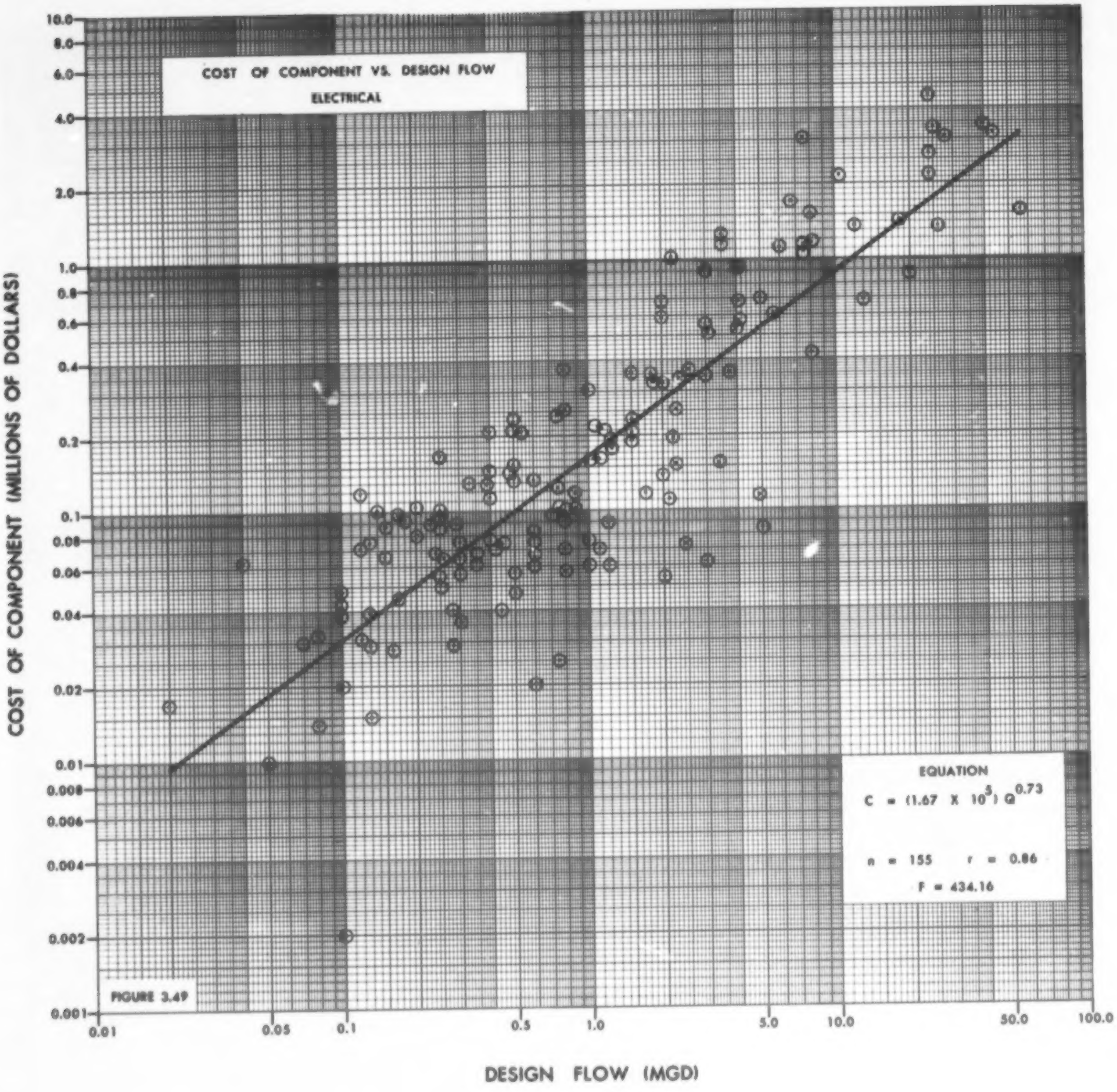

COST OF COMPONENT VS. DESIGN FLOW
ELECTRICAL
EQUATION
C = (1.67 X 10^5) Q^0.73
n = 155 r = 0.86
F = 434.16
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.49

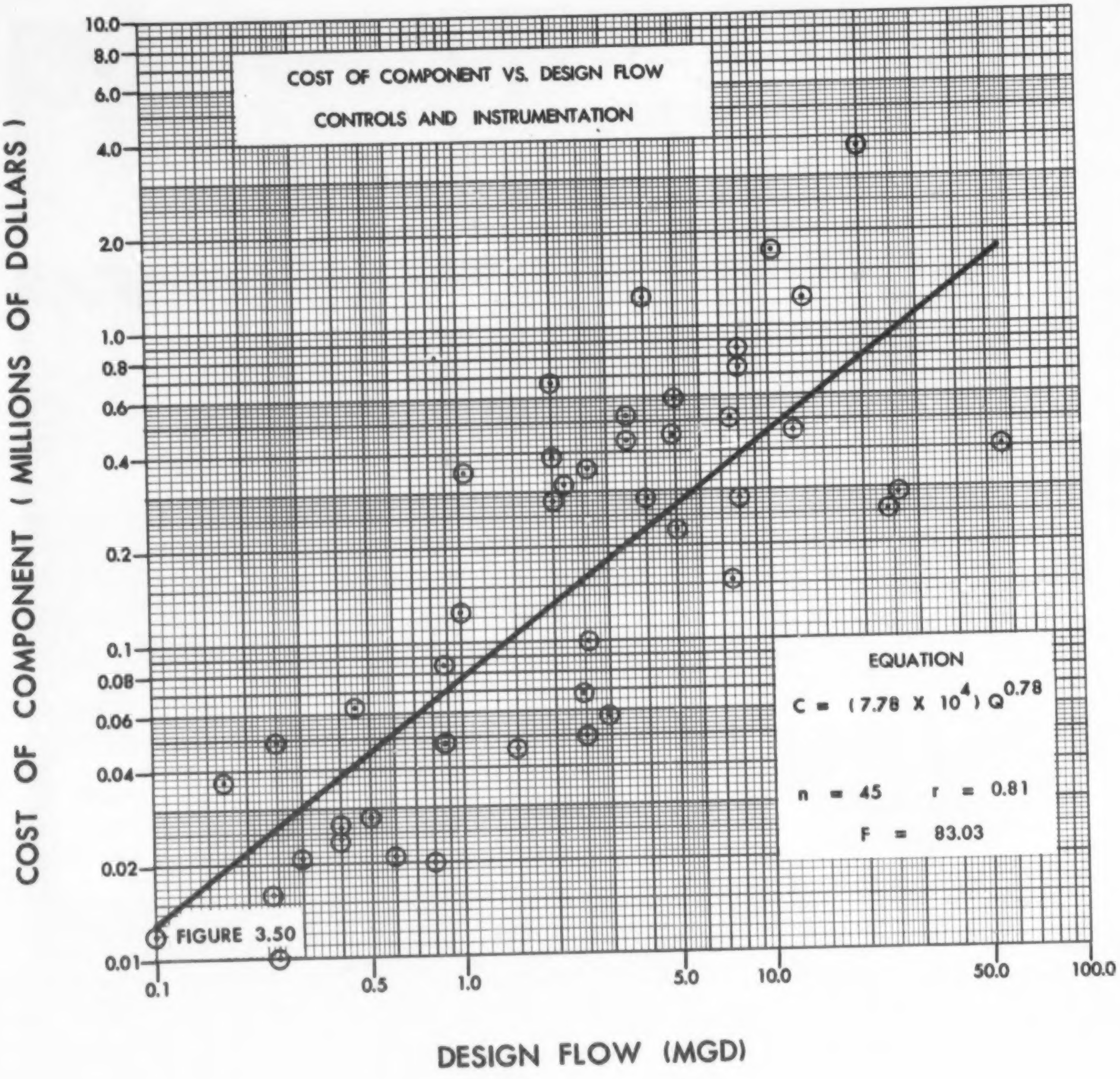


FIGURE 3.50
COST OF COMPONENT VS. DESIGN FLOW
CONTROLS AND INSTRUMENTATION
EQUATION
C = (7.78 X 10^4) Q^0.78
n = 45
r = 0.81
F = 83.03
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

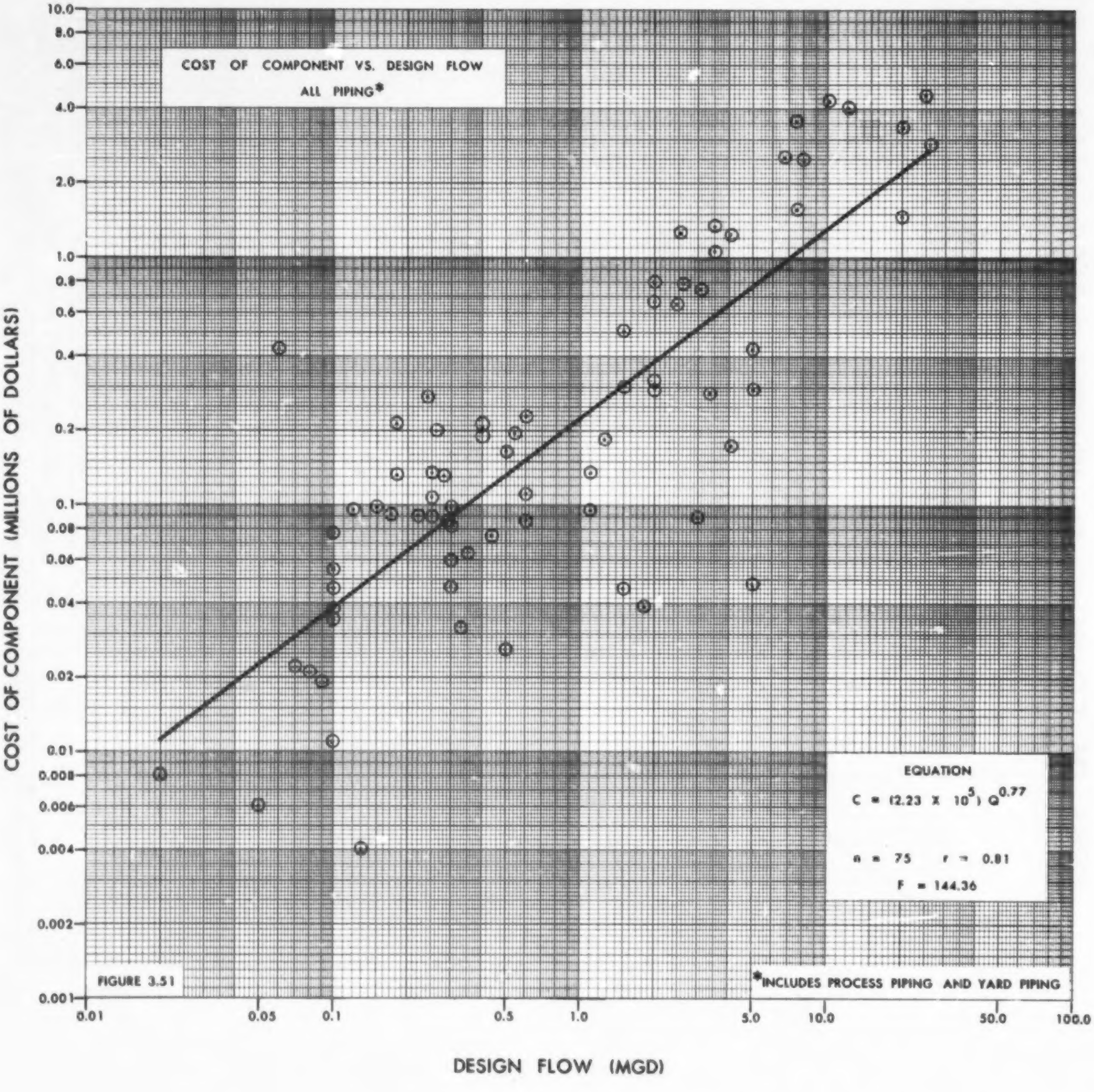
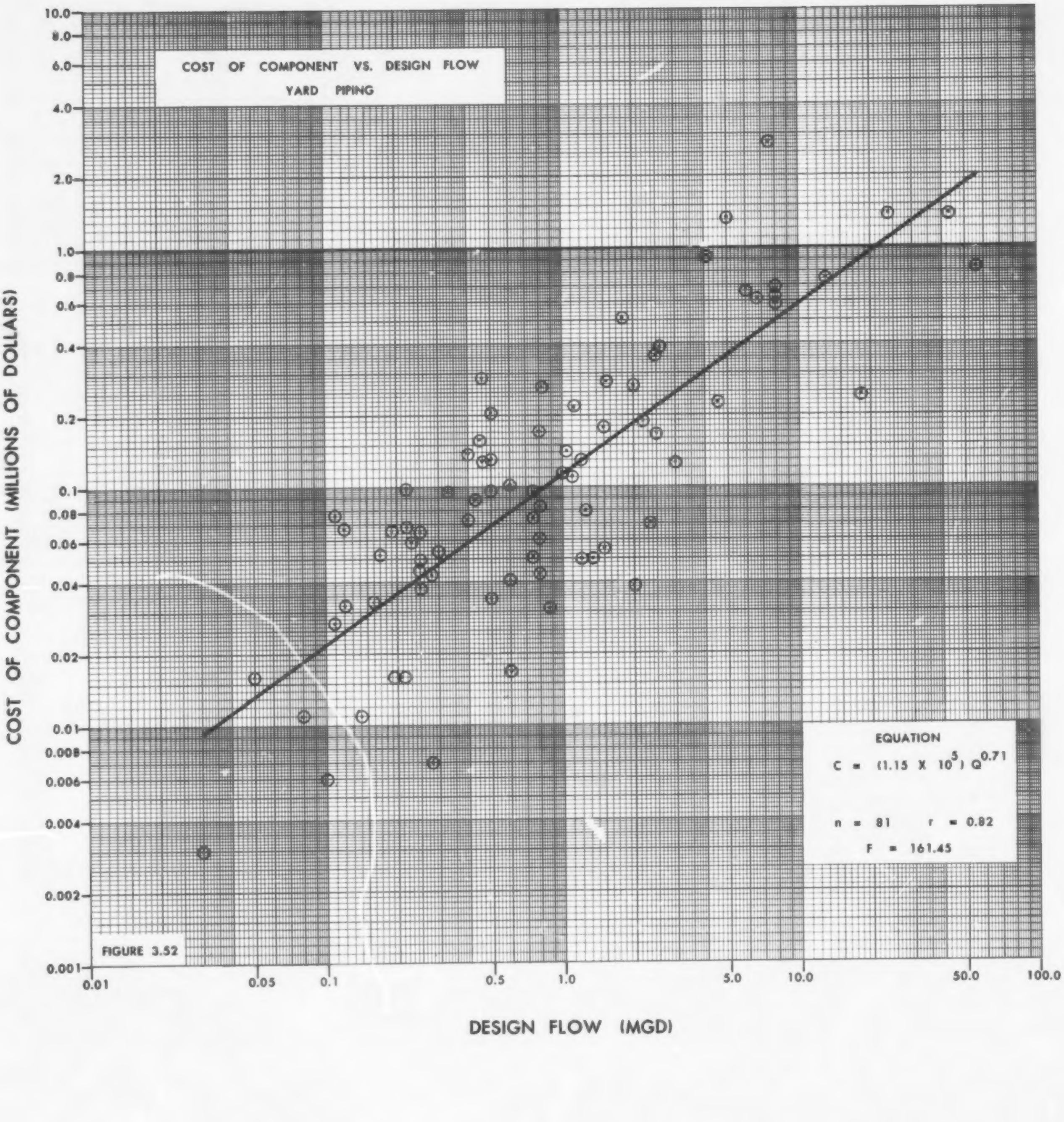


FIGURE 3.51

COST OF COMPONENT VS. DESIGN FLOW
ALL PIPING*

*INCLUDES PROCESS PIPING AND YARD PIPING


COST OF COMPONENT VS. DESIGN FLOW
YARD PIPING
EQUATION
C = (1.15 X 10^5) Q^0.71
n = 81 r = 0.82
F = 161.45
FIGURE 3.52
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

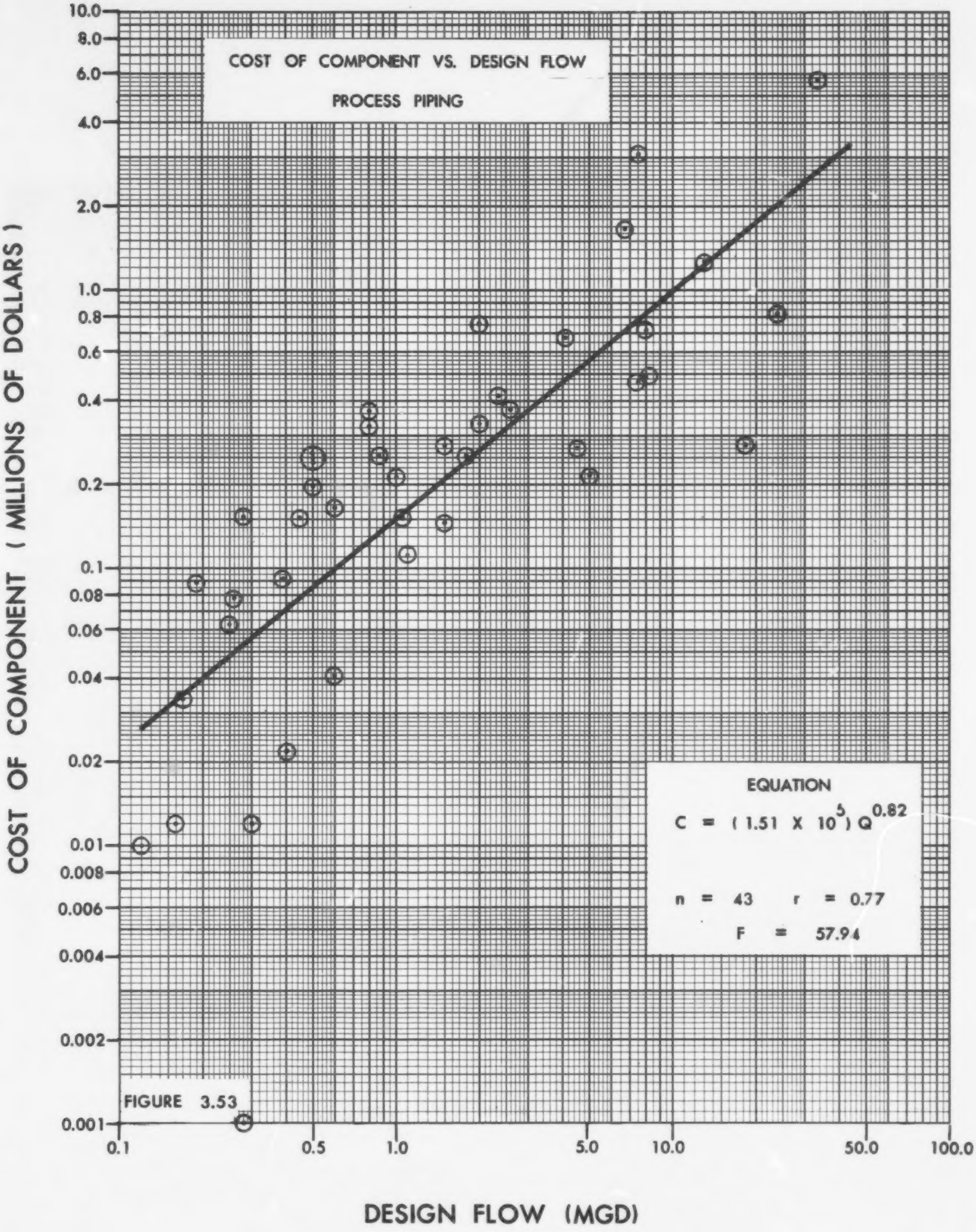

COST OF COMPONENT VS. DESIGN FLOW
PROCESS PIPING
EQUATION
C = (1.51 X 10^5) Q^0.82
n = 43 r = 0.77
F = 57.94
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.53

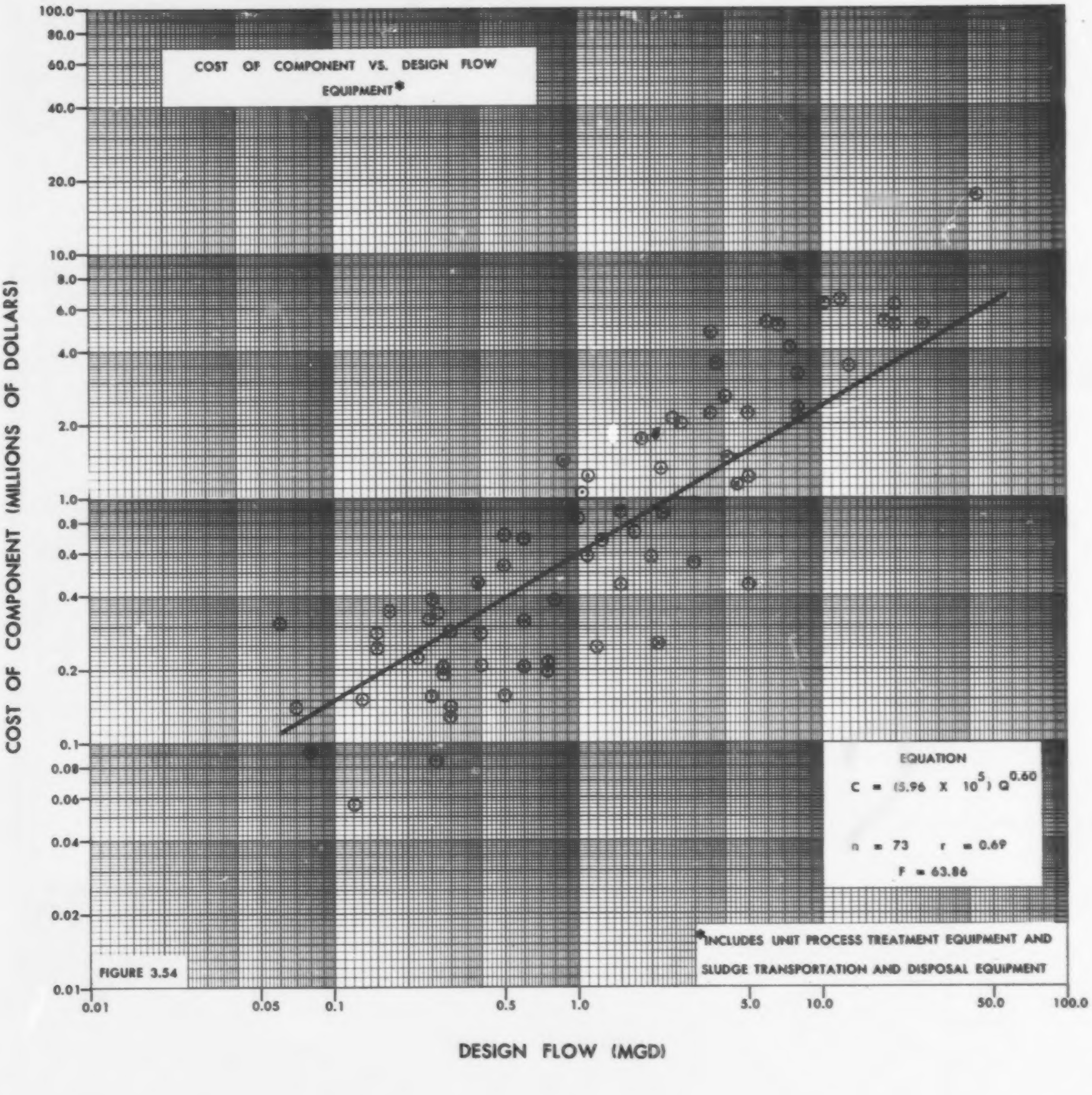

COST OF COMPONENT VS. DESIGN FLOW EQUIPMENT*

FIGURE 3.54

EQUATION

$C = (5.96 \times 10^{5})\,Q^{0.60}$

$n = 73 \quad r = 0.69$

$F = 63.86$

*INCLUDES UNIT PROCESS TREATMENT EQUIPMENT AND SLUDGE TRANSPORTATION AND DISPOSAL EQUIPMENT

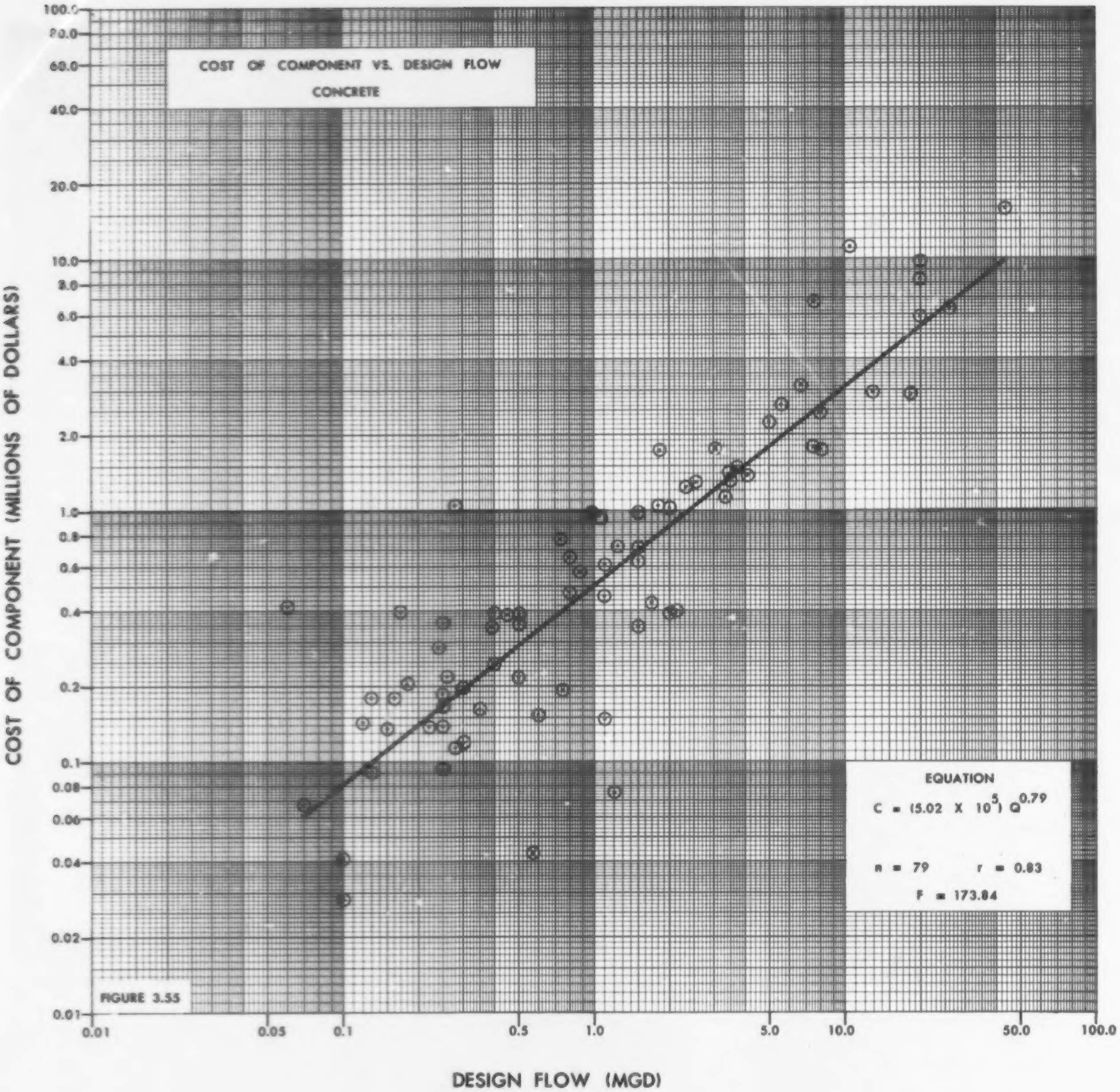


FIGURE 3.55

COST OF COMPONENT VS. DESIGN FLOW

CONCRETE

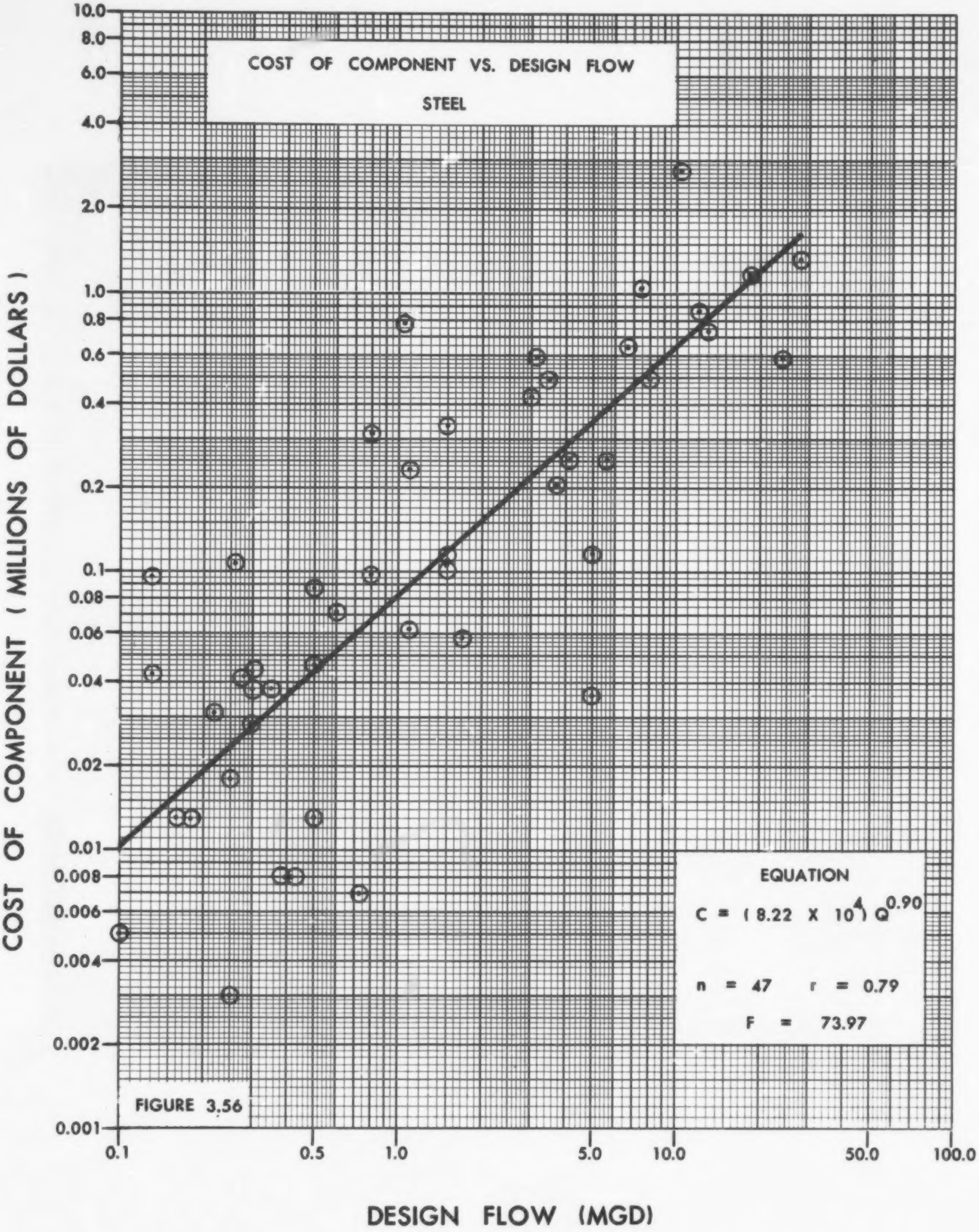


FIGURE 3.56

COST OF COMPONENT VS. DESIGN FLOW
STEEL
EQUATION
C = (8.22 X 10^4) Q^0.90
n = 47 r = 0.79
F = 73.97
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.008
0.006
0.004
0.002
0.001
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

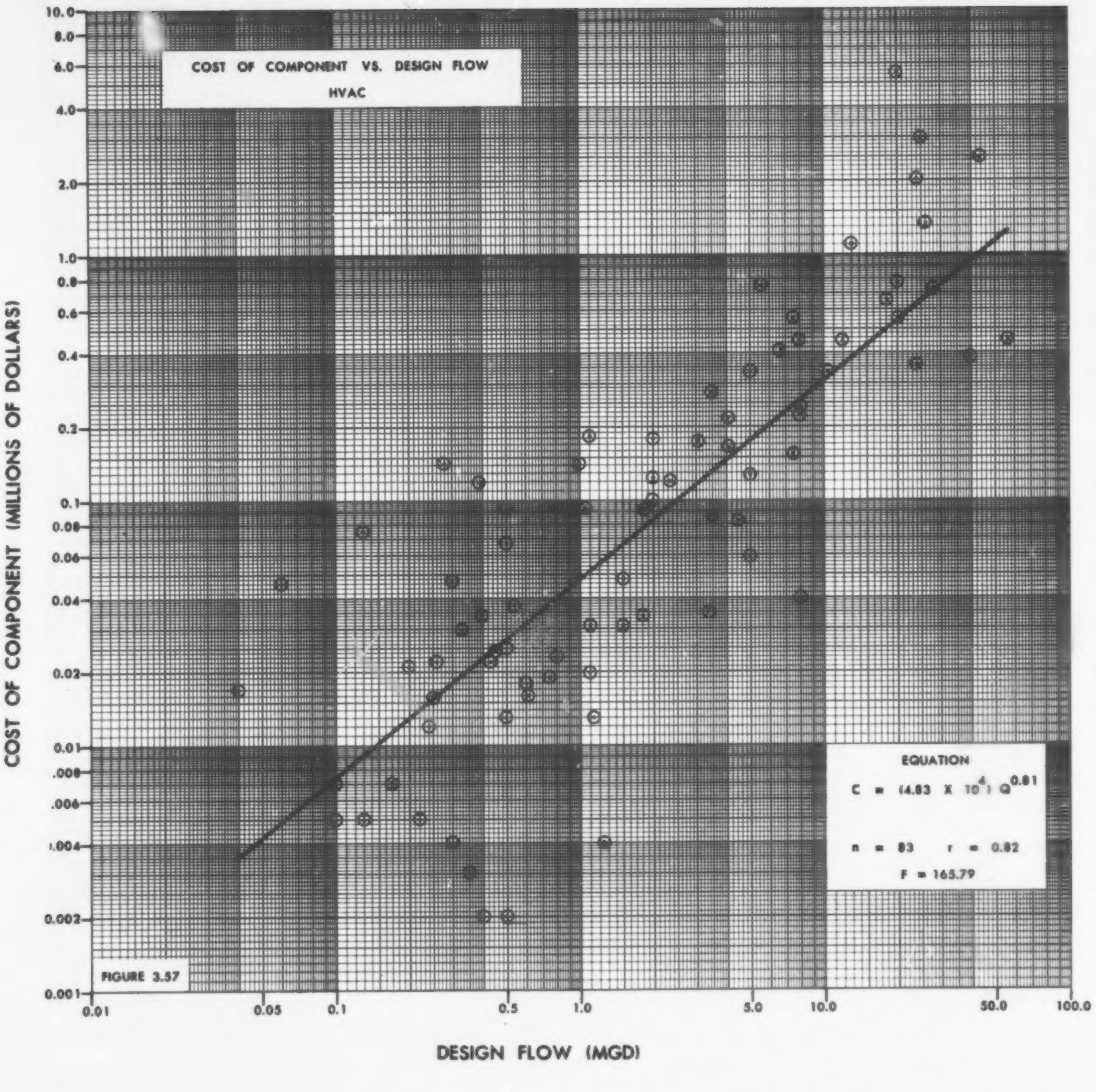


FIGURE 3.57

COST OF COMPONENT VS. DESIGN FLOW
HVAC
EQUATION
C = (4.83 X 10^4) Q^0.81
n = 83 r = 0.82
F = 165.79
COST OF COMPONENT (MILLIONS OF DOLLARS)
DESIGN FLOW (MGD)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
.008
.006
.004
0.002
0.001
0.01
0.05
0.1
0.5
1.0
5.0
10.0
50.0
100.0

THIRD ORDER COSTS

As data were collected from the grant files, it was often possible to define several component costs for unit processes. A total of five component costs were collected in sufficient quantity to attempt a statistical analysis for certain unit processes. These are:

1. Concrete
2. Equipment
3. Electrical
4. Piping
5. Excavation

As with the total plant component costs discussed under Second Order curves, these are "in place" costs including all labor and materials necessary to install or construct each component. Additionally, the component costs for unit processes which include a reactor basin followed by a clarifier, such as activated sludge, include the costs for both structures.

Figures 3.58 through 3.68 present the Third Order unit process costs for ten commonly used unit processes, as well as the control/lab/maintenance building. As more data becomes available, it is anticipated that more such analyses will be possible.

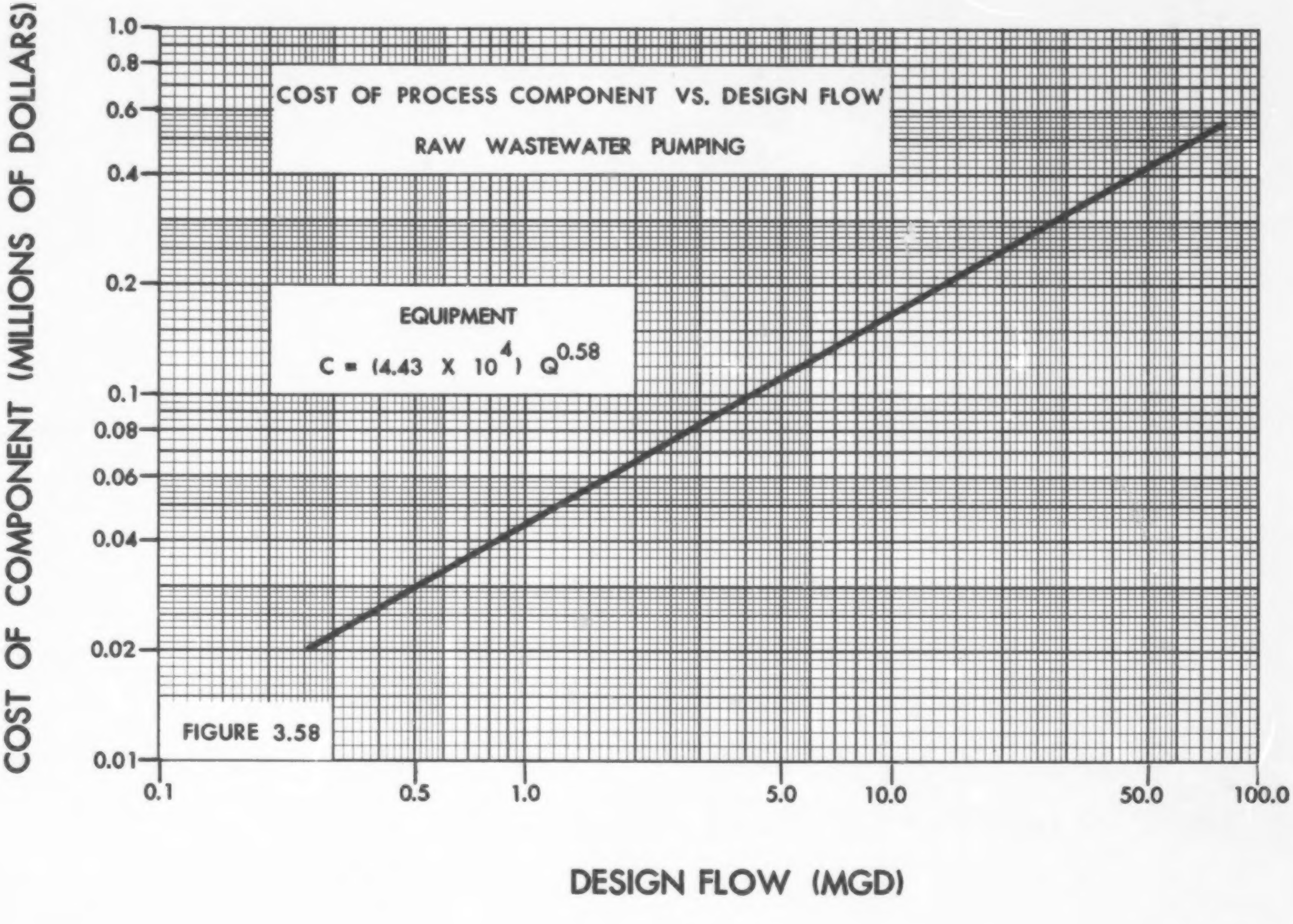


FIGURE 3.58

COST OF PROCESS COMPONENT VS. DESIGN FLOW

RAW WASTEWATER PUMPING

EQUIPMENT

$C = (4.43 \times 10^4)\ Q^{0.58}$

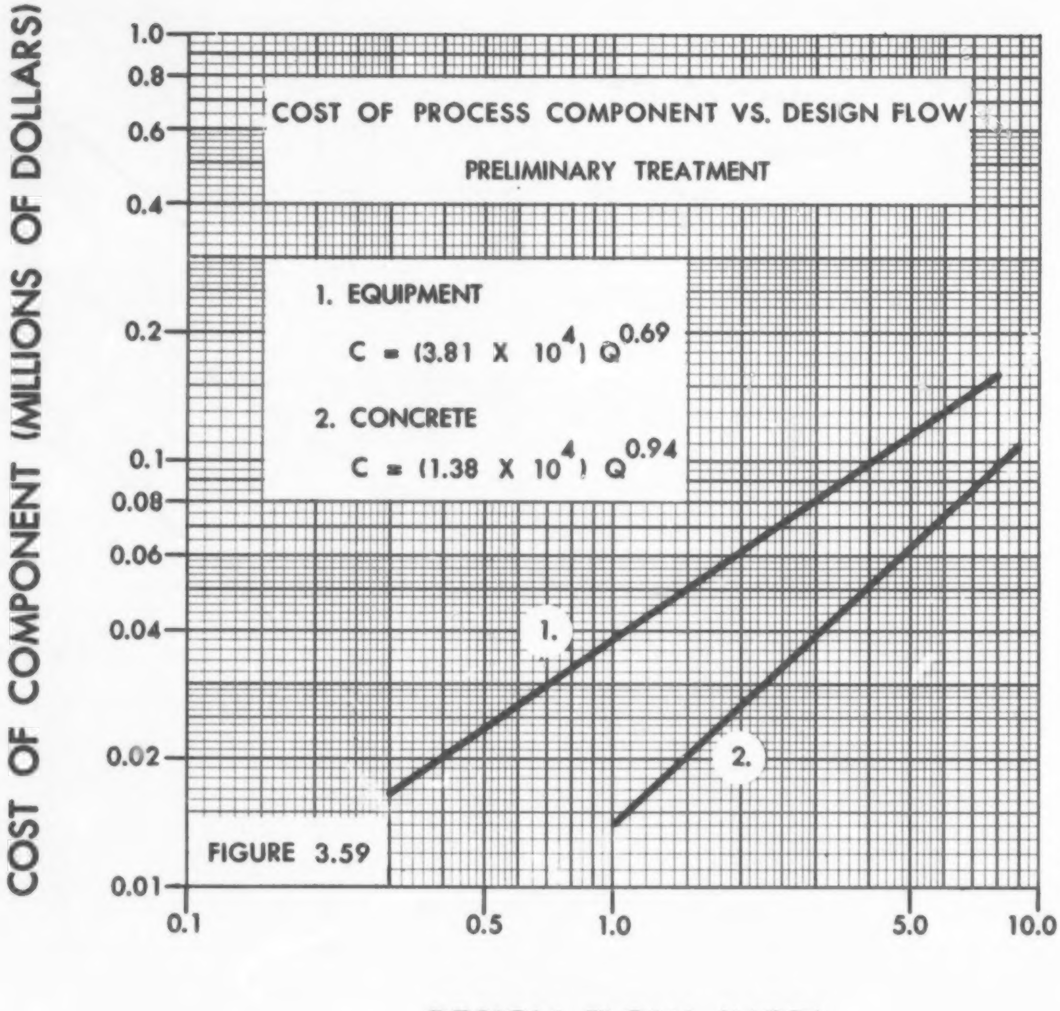


FIGURE 3.59

COST OF PROCESS COMPONENT VS. DESIGN FLOW

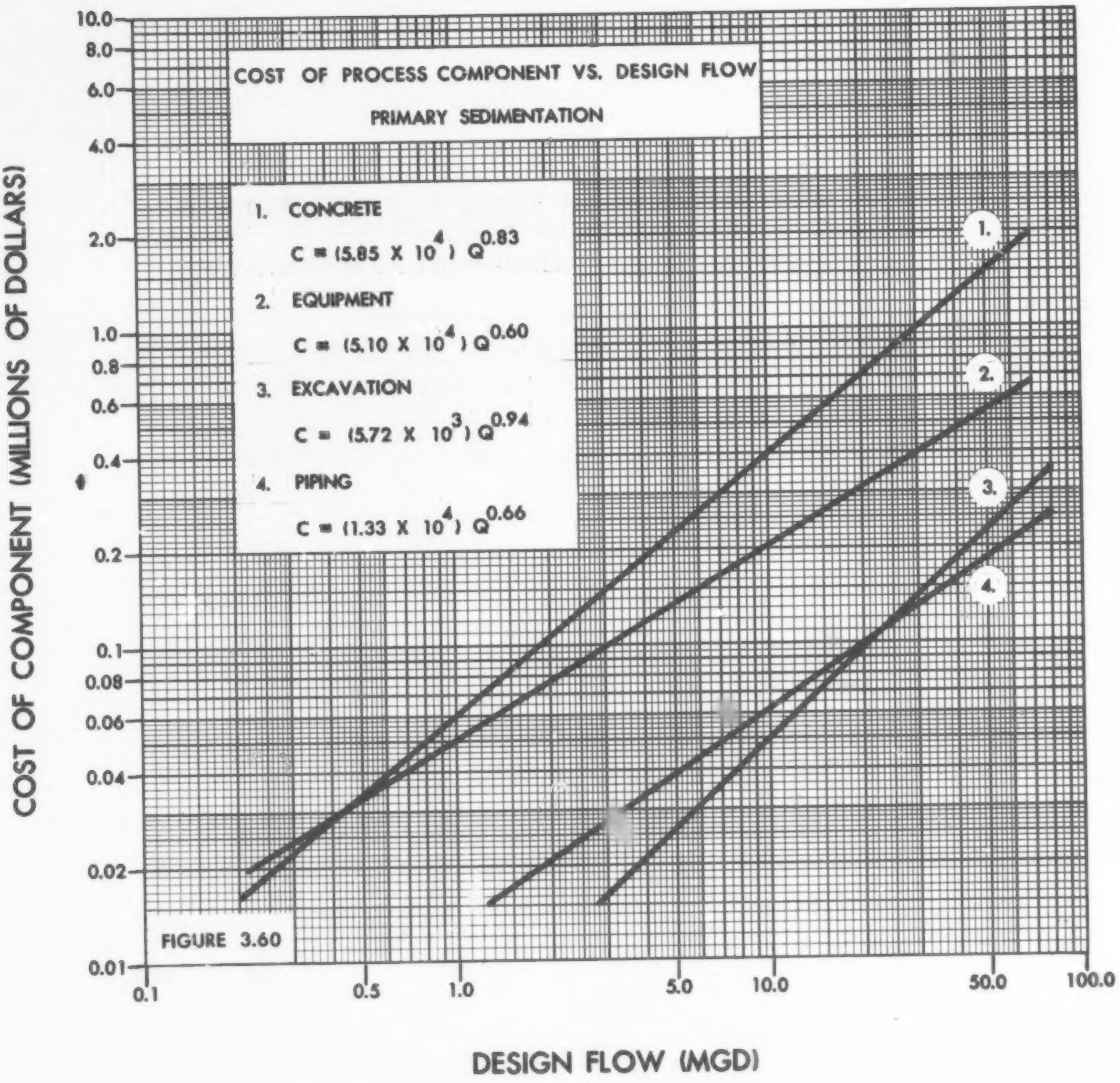
PRELIMINARY TREATMENT

1. EQUIPMENT

$C = (3.81 \times 10^4)\, Q^{0.69}$

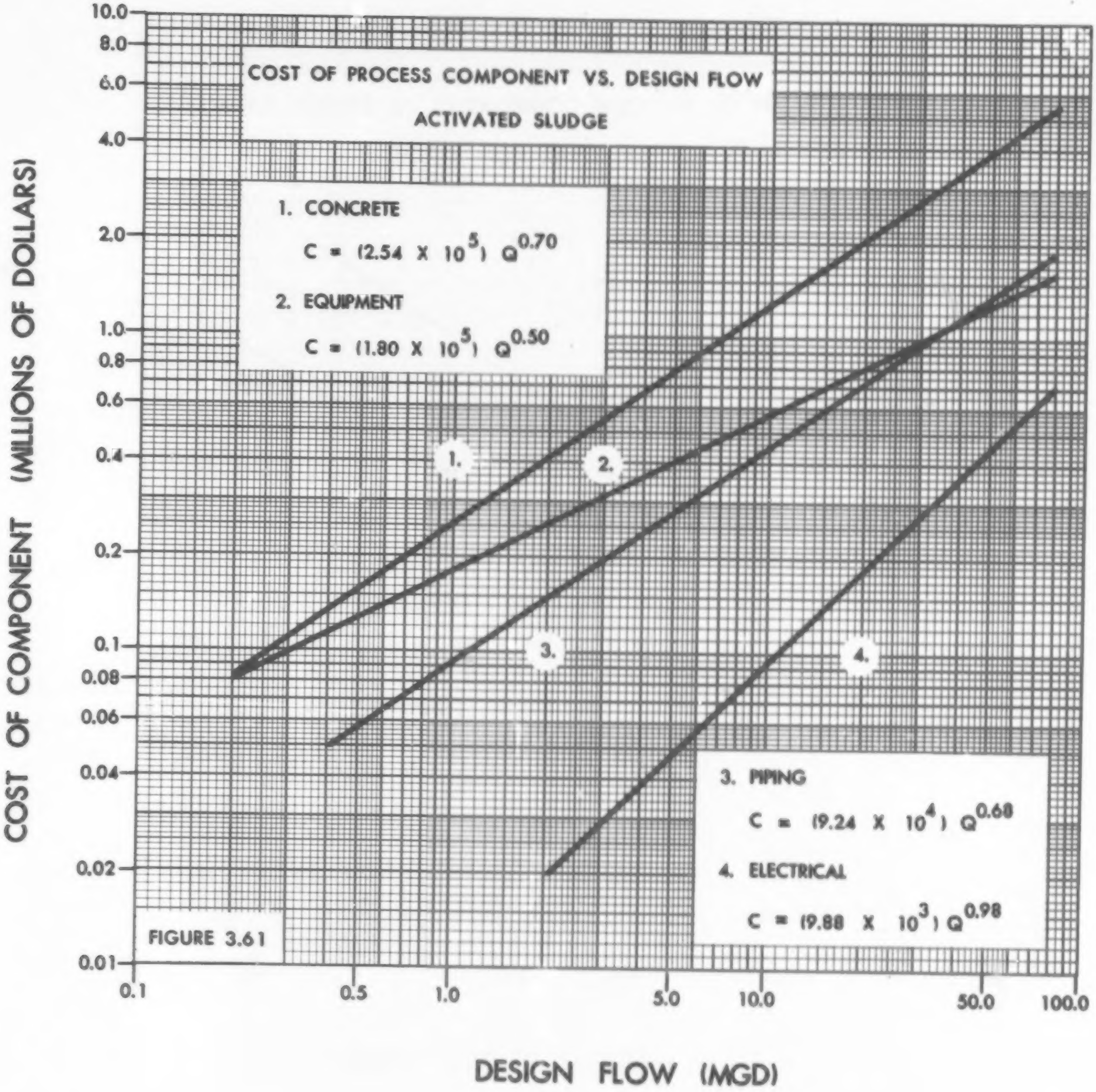
2. CONCRETE

$C = (1.38 \times 10^4)\, Q^{0.94}$



COST OF PROCESS COMPONENT VS. DESIGN FLOW
PRIMARY SEDIMENTATION
1. CONCRETE
$C = (5.85 \times 10^4)\ Q^{0.83}$
2. EQUIPMENT
$C = (5.10 \times 10^4)\ Q^{0.60}$
3. EXCAVATION
$C = (5.72 \times 10^3)\ Q^{0.94}$
4. PIPING
$C = (1.33 \times 10^4)\ Q^{0.66}$
1.
2.
3.
4.
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

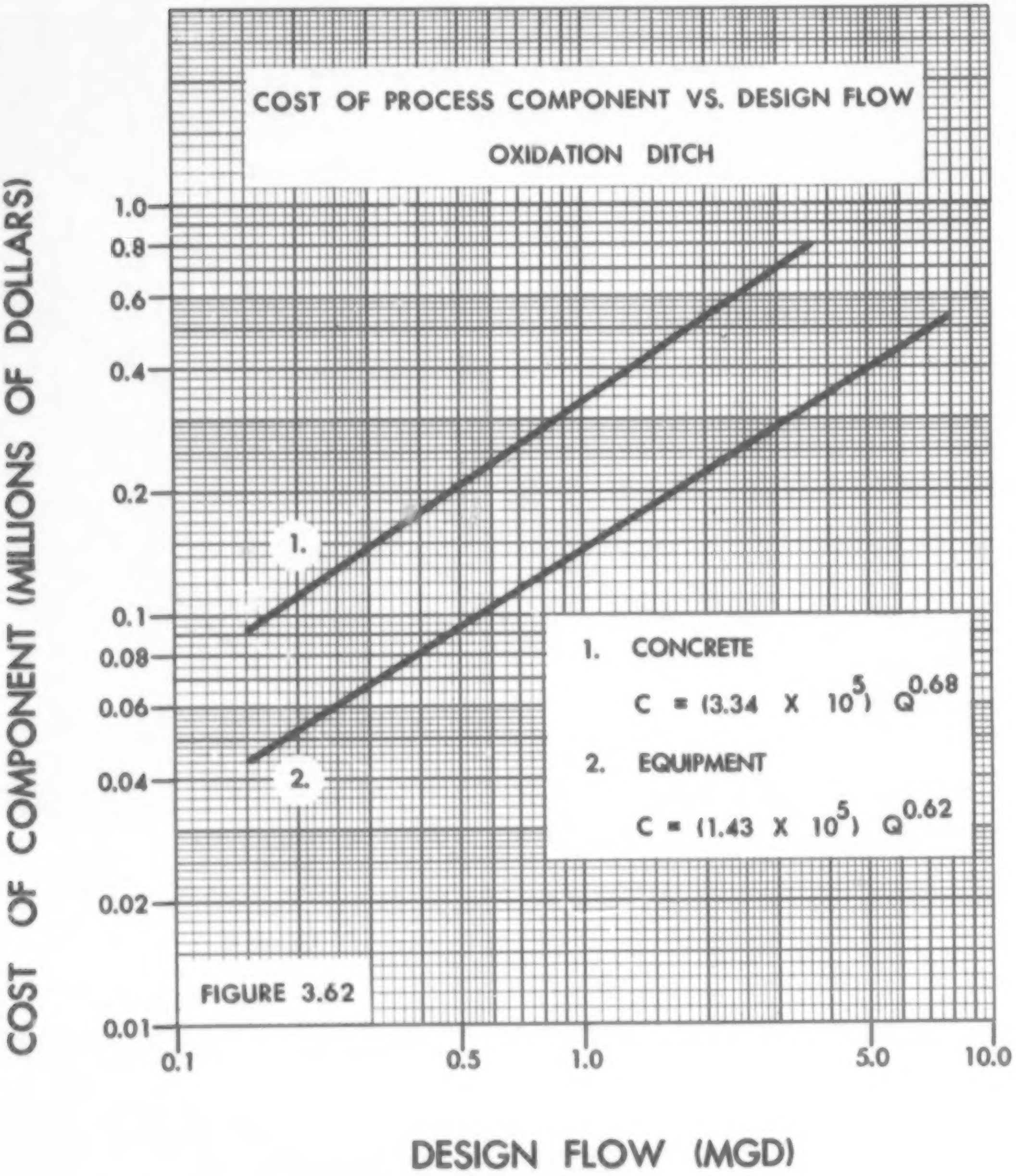
FIGURE 3.60



COST OF PROCESS COMPONENT VS. DESIGN FLOW

ACTIVATED SLUDGE

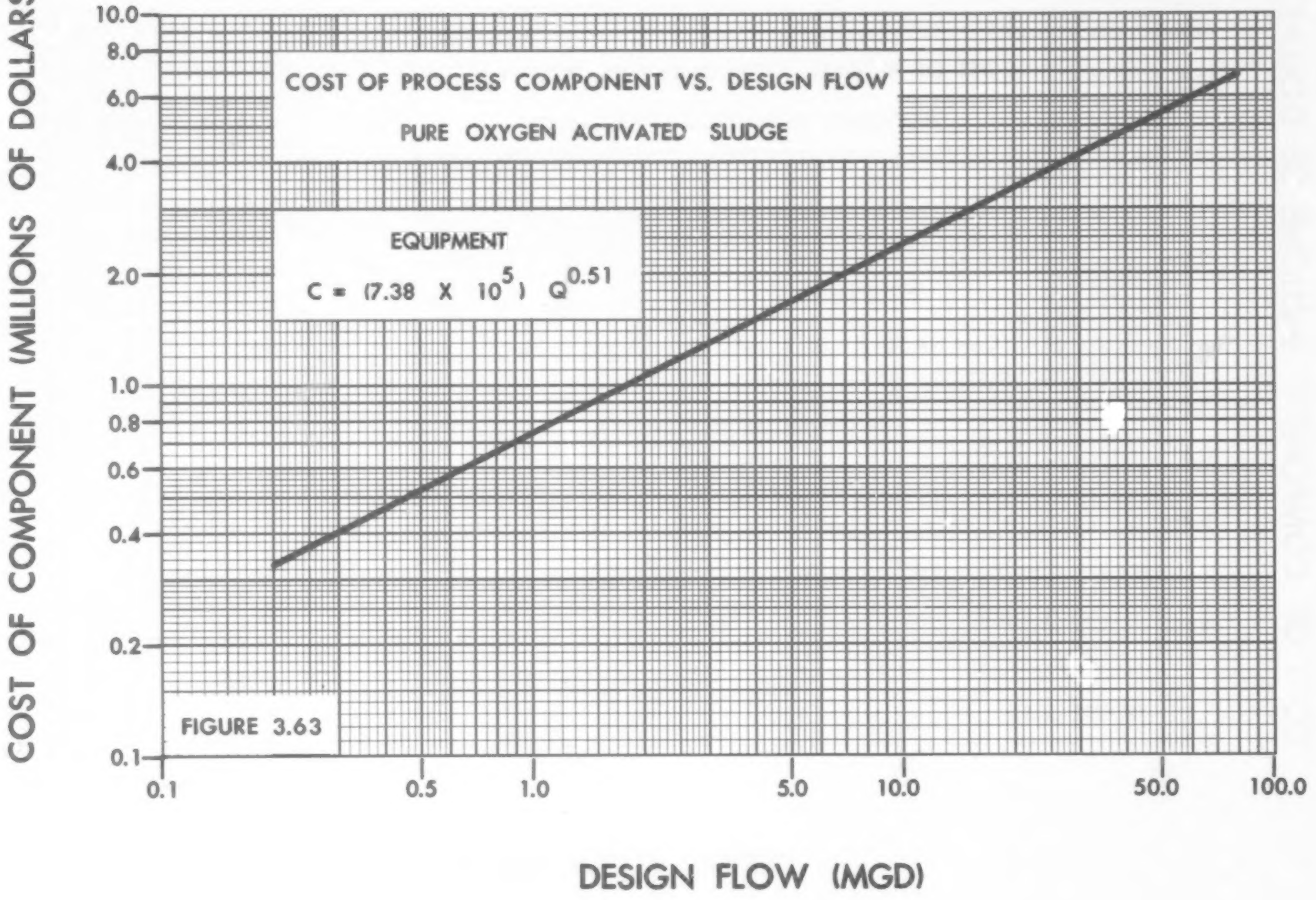
FIGURE 3.61



COST OF PROCESS COMPONENT VS. DESIGN FLOW

OXIDATION DITCH

FIGURE 3.62



COST OF PROCESS COMPONENT VS. DESIGN FLOW

PURE OXYGEN ACTIVATED SLUDGE

EQUIPMENT

$C = (7.38 \times 10^5)\ Q^{0.51}$

FIGURE 3.63

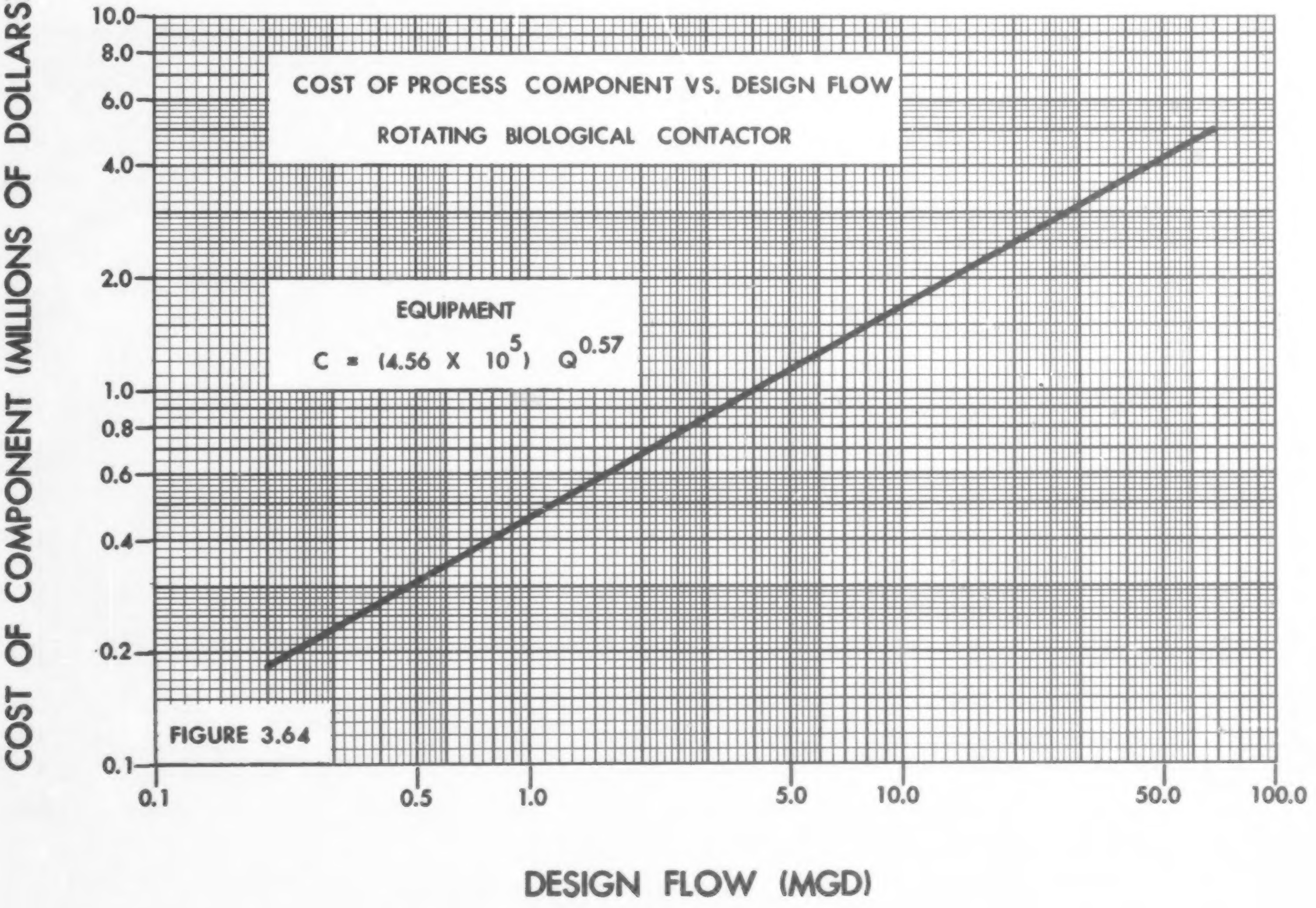


FIGURE 3.64

COST OF PROCESS COMPONENT VS. DESIGN FLOW
ROTATING BIOLOGICAL CONTACTOR
EQUIPMENT
$C = (4.56 \times 10^5) Q^{0.57}$
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

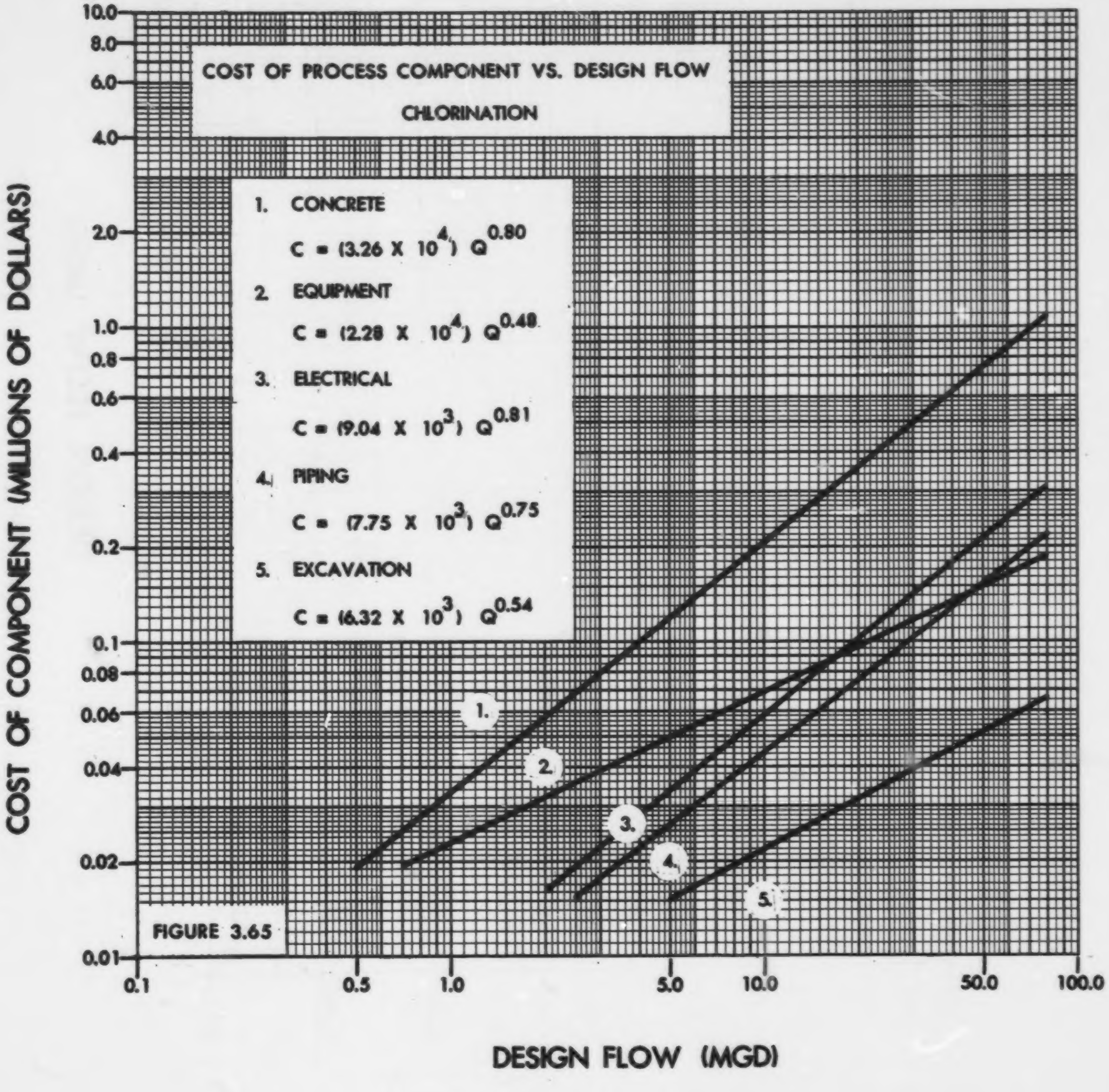

COST OF PROCESS COMPONENT VS. DESIGN FLOW
CHLORINATION
1. CONCRETE
$C = (3.26 \times 10^4)\ Q^{0.80}$
2. EQUIPMENT
$C = (2.28 \times 10^4)\ Q^{0.48}$
3. ELECTRICAL
$C = (9.04 \times 10^3)\ Q^{0.81}$
4. PIPING
$C = (7.75 \times 10^3)\ Q^{0.75}$
5. EXCAVATION
$C = (6.32 \times 10^3)\ Q^{0.54}$
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
1.
2.
3.
4.
5.
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

FIGURE 3.65

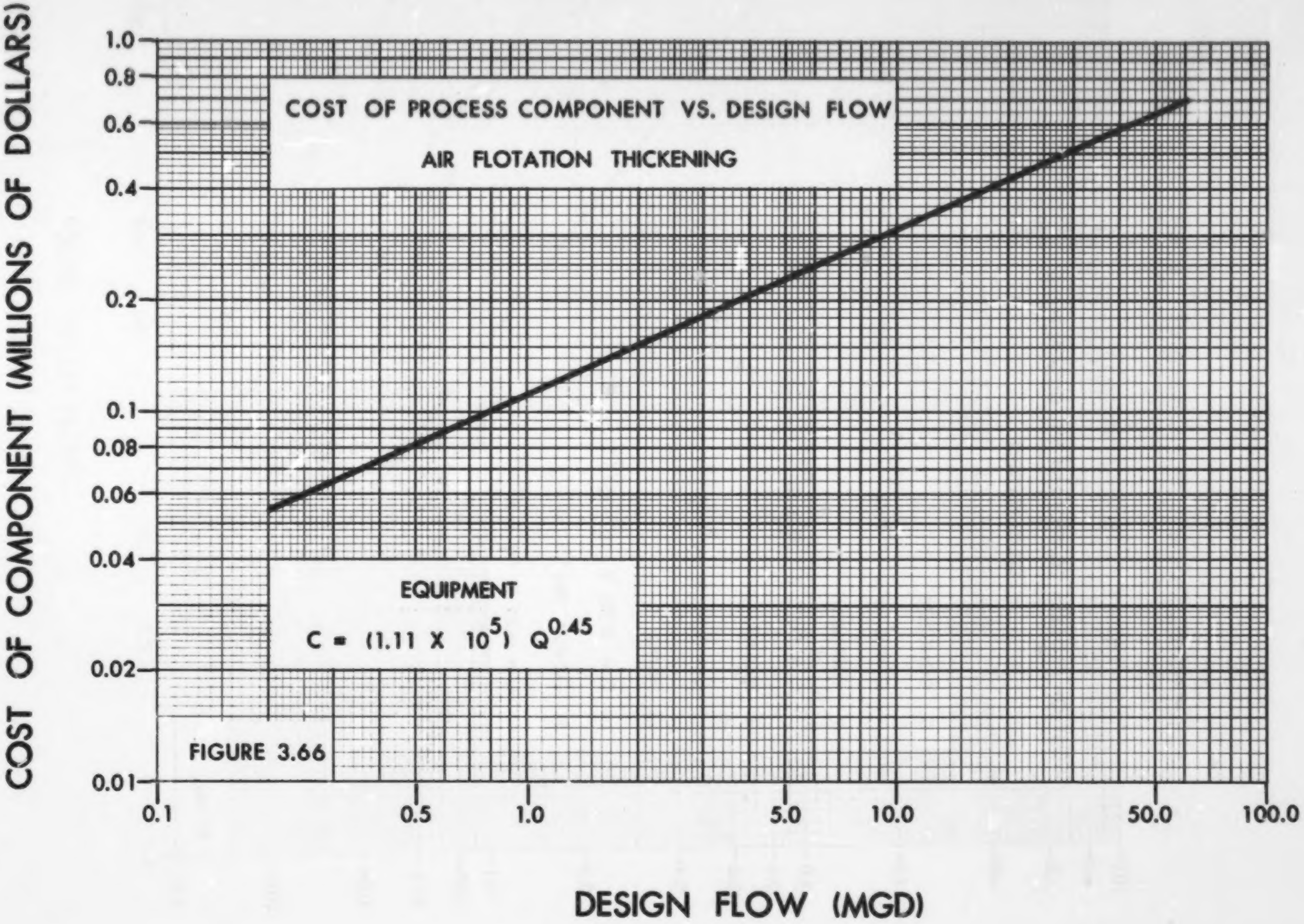


FIGURE 3.66

COST OF PROCESS COMPONENT VS. DESIGN FLOW
AIR FLOTATION THICKENING
EQUIPMENT
$C = (1.11 \times 10^5)\ Q^{0.45}$
COST OF COMPONENT (MILLIONS OF DOLLARS)
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)

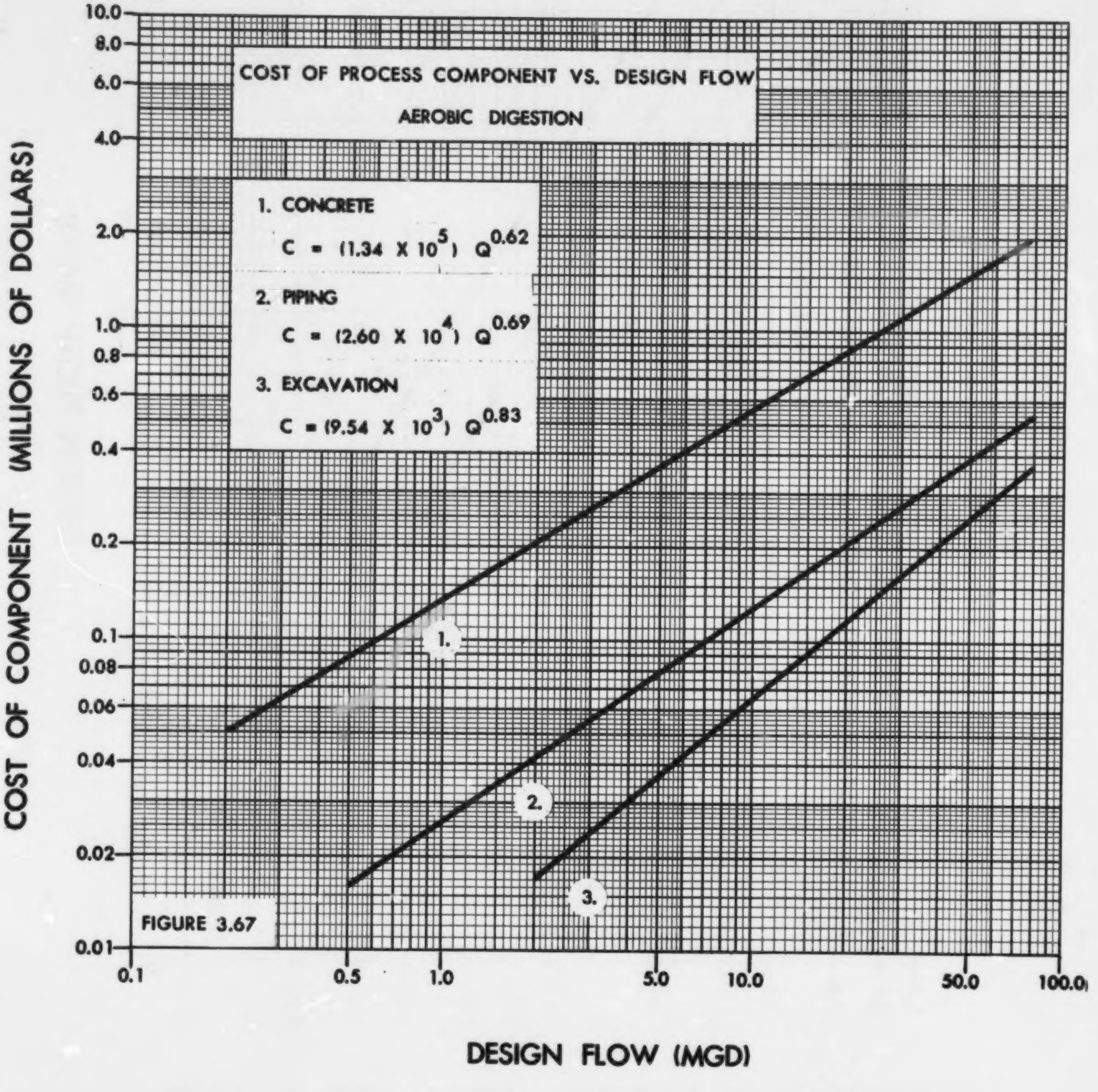
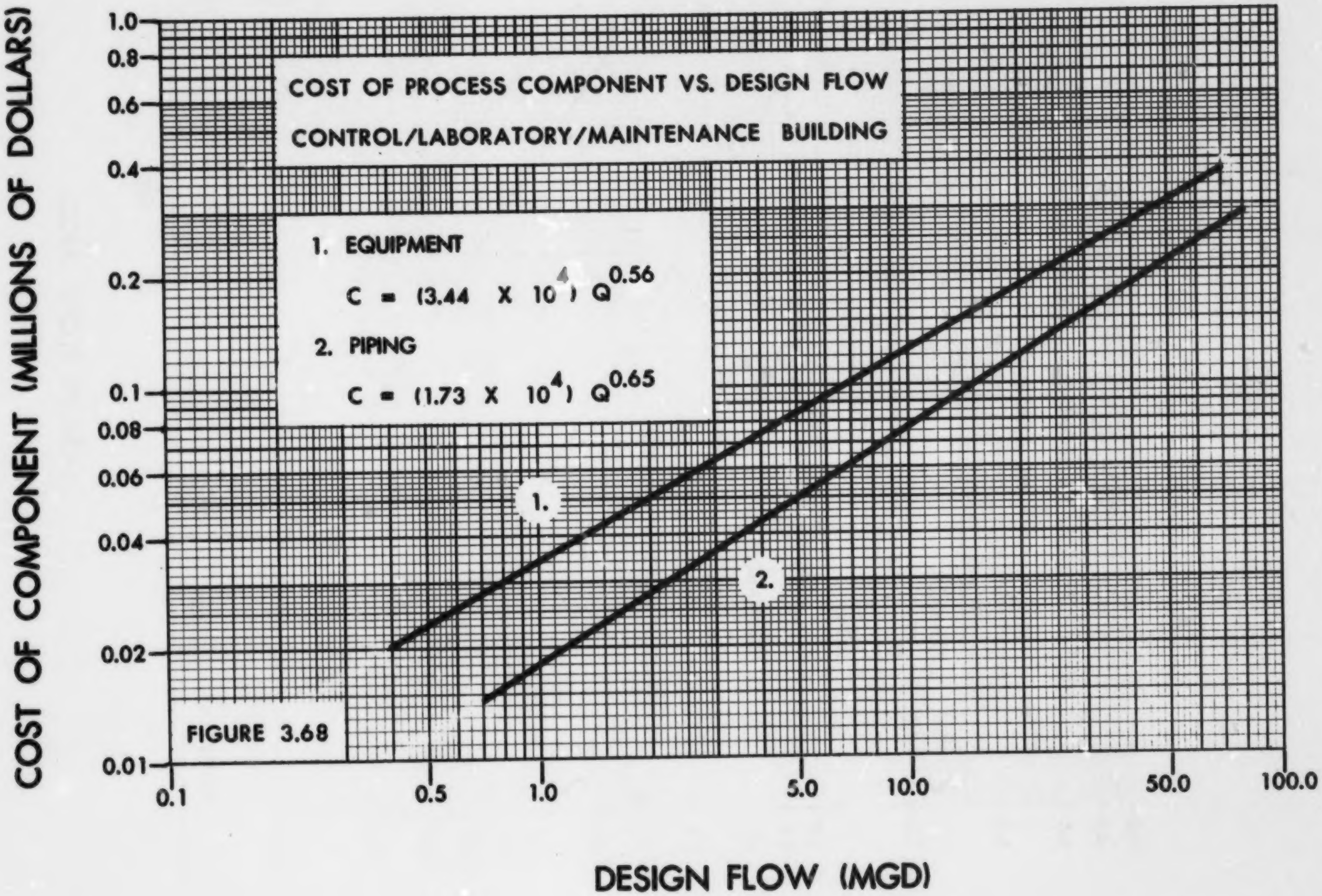

COST OF PROCESS COMPONENT VS. DESIGN FLOW
AEROBIC DIGESTION
1. CONCRETE
C = (1.34 X 10^5) Q^0.62
2. PIPING
C = (2.60 X 10^4) Q^0.69
3. EXCAVATION
C = (9.54 X 10^3) Q^0.83
COST OF COMPONENT (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0.02
0.01
0.1
0.5
1.0
5.0
10.0
50.0
100.0
DESIGN FLOW (MGD)
1.
2.
3.

FIGURE 3.67



COST OF PROCESS COMPONENT VS. DESIGN FLOW
CONTROL/LABORATORY/MAINTENANCE BUILDING

1. EQUIPMENT

$C = (3.44 \times 10^{4})\, Q^{0.56}$

2. PIPING

$C = (1.73 \times 10^{4})\, Q^{0.65}$

FIGURE 3.68

4.0 SIMPLIFIED TREATMENT COST ESTIMATION TECHNIQUES

INTRODUCTION

This section presents simplified techniques for the estimation of the project costs for the construction, enlargement, and upgrading of municipal wastewater treatment facilities. These procedures are intended for the use of State and municipal officials, as well as concerned laymen in determining the approximate capital costs of wastewater treatment alternatives.

These cost estimating procedures were developed for use in the 1980 Needs Survey by EPA. Needs Surveys are conducted biennially by the agency in order to assess the cost of providing sewage collection and treatment as required by Public Law 95-217, and to report these costs to Congress. Previous Needs Surveys have been conducted in 1973, 1974, 1976, and 1978.

COST ESTIMATING TECHNIQUES

The curves shown in Figures 4.1 and 4.2 have been developed to estimate costs of mechanical plants and lagoons respectively. These curves were developed from the same data base utilized in developing the plotted relationships in Section 3.0. These curves present the entire project costs for wastewater treatment plant projects including the construction costs; Step III nonconstruction costs such as administration/legal, architect/engineer fees, and contingencies; and Step I and Step II planning costs. Thus, the curves differ significantly from those presented in Section 3.0 which only include construction costs.

Figure 4.1 may be used to estimate the construction costs for mechanical wastewater treatment plants. All costs represented by the curves have been adjusted to Kansas City/St. Joseph, Missouri and are in fourth quarter 1978 dollars. To adjust costs for another geographical area of the United States, refer to Map 1, Figure 4.3 and the Area Multipliers in Table 4.1.

New construction costs may be determined by reading directly from one of the cost curves 1 through 4, whichever is appropriate for the level of treatment sought. Likewise, enlargement costs for a given level of treatment may be determined by using curves 1 through 4 and the flow to which the facility is projected to be enlarged.

For instances in which existing facilities must be upgraded or enlarged and upgraded from one level of treatment to a higher level, costs are determined by estimating the new construction cost for the projected design flow and level of treatment from the appropriate curve and then deducting an allowance for usable portions of the existing facility. Curves A and B provide estimates of the deduct values for existing primary and secondary plants, respectively. No curves have been established for estimating the salvage value of existing facilities greater than secondary.

The costs for aerated lagoons and stabilization ponds designed to meet secondary treatment requirements may be estimated from Figure 4.2. Costs include the costs for a complete lagoon facility including nominal pretreatment, pumping, and laboratory/maintenance facilities. Costs from both aerated lagoon and stabilization pond projects have been combined in this curve. Costs at the lower end of the curve tend to represent the costs for stabilization pond projects while those at the upper end of the curves are generally aerated lagoon projects.

EXAMPLES

The following examples are provided to illustrate treatment plant cost estimates using procedures outlined in this section.

Example 1

Estimate the total project cost for a new 2.0 mgd activated sludge secondary treatment plant in Columbia, Missouri.

Curve 1 (Figure 4.1) at 2.0 mgd	$4,382,000
Columbia, Missouri Area Multiplier from Figure 4.3 and Table 4.1	x 0.71
Columbia, Missouri Project Cost	$3,111,000

Example 2

Estimate the cost of enlarging an existing advanced secondary treatment (AST) plant in Billings, Montana from 4.0 mgd to 5.5 mgd.

Curve 2 (Figure 4.1) at 1.5 mgd	$3,741,000
Denver, Colorado Area Multiplier from Figure 4.3 and Table 4.1	x 0.93
Billings, Montana Project Cost	$3,479,000

Example 3

Estimate the cost of enlarging and upgrading an existing 2.0 mgd primary treatment plant in Gainesville, Florida to a 5.0 mgd advanced wastewater treatment (AWT) plant.

New Construction Cost for 5.0 mgd AWT Plant Curve 3 (Figure 4.1) at 5.0 mgd	$10,397,000
Curve A at 2.0 mgd	- 702,000
	$ 9,695,000
Birmingham, Alabama Area Multiplier from Figure 4.3 and Table 4.1	x 0.75
Gainesville, Florida Project Cost	$ 7,271,000

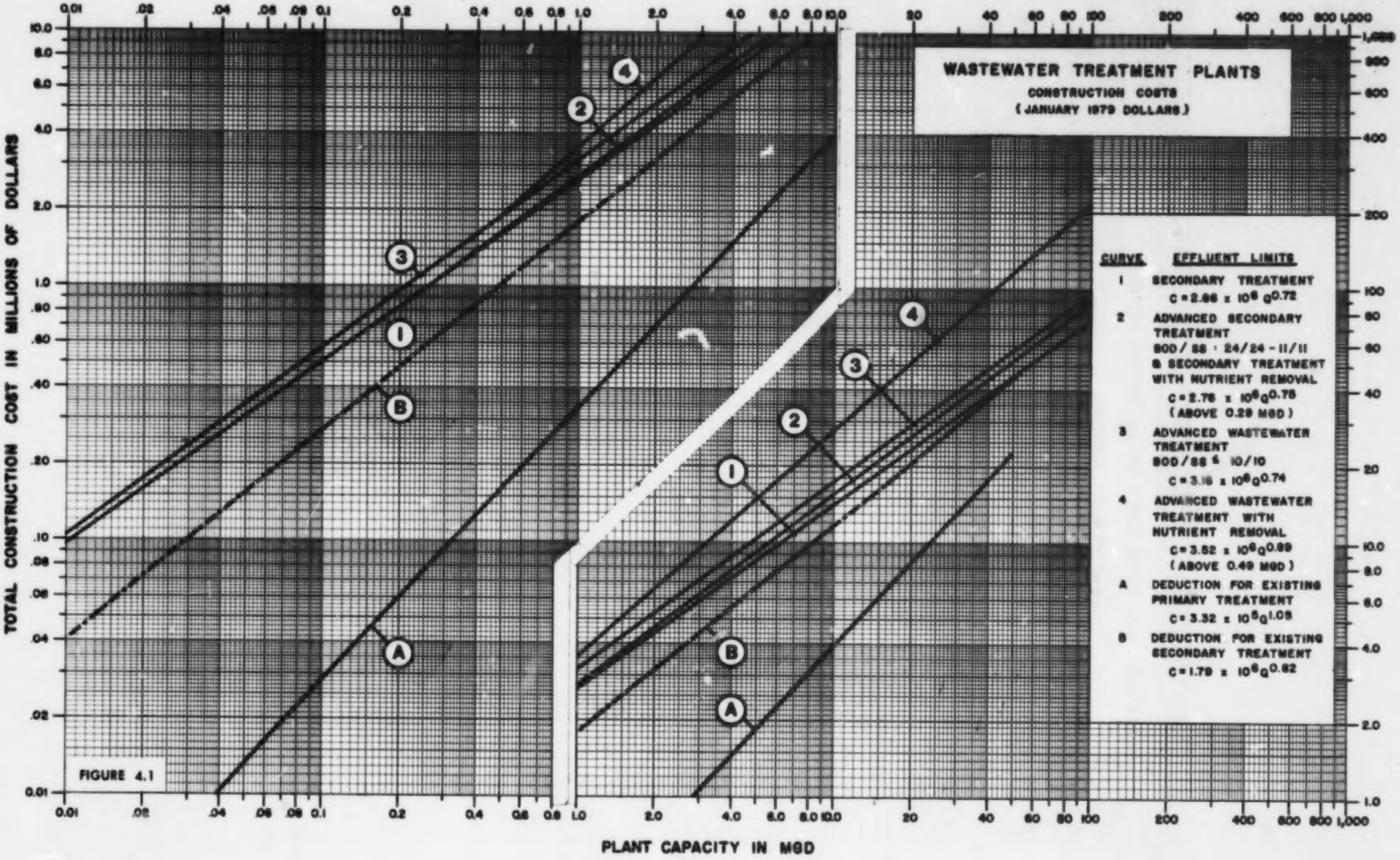

WASTEWATER TREATMENT PLANTS
CONSTRUCTION COSTS
(JANUARY 1979 DOLLARS)
CURVE EFFLUENT LIMITS
1 SECONDARY TREATMENT
C = 2.86 x 10^6 Q^0.72
2 ADVANCED SECONDARY TREATMENT
BOD / SS : 24/24 - 11/11
& SECONDARY TREATMENT WITH NUTRIENT REMOVAL
C = 2.76 x 10^6 Q^0.76
(ABOVE 0.29 MGD)
3 ADVANCED WASTEWATER TREATMENT
BOD / SS ≤ 10/10
C = 3.16 x 10^6 Q^0.74
4 ADVANCED WASTEWATER TREATMENT WITH NUTRIENT REMOVAL
C = 3.52 x 10^6 Q^0.89
(ABOVE 0.49 MGD)
A DEDUCTION FOR EXISTING PRIMARY TREATMENT
C = 3.32 x 10^6 Q^1.08
B DEDUCTION FOR EXISTING SECONDARY TREATMENT
C = 1.79 x 10^6 Q^0.82
TOTAL CONSTRUCTION COST IN MILLIONS OF DOLLARS
PLANT CAPACITY IN MGD
0.01
.02
.04
.06
.08
0.1
0.2
0.4
0.6
0.8
1.0
2.0
4.0
6.0
8.0
10.0
20
40
60
80
100
200
400
600
800
1,000
.10
.20
.40
.60
.80
1,000
1
2
3
4
A
B

FIGURE 4.1

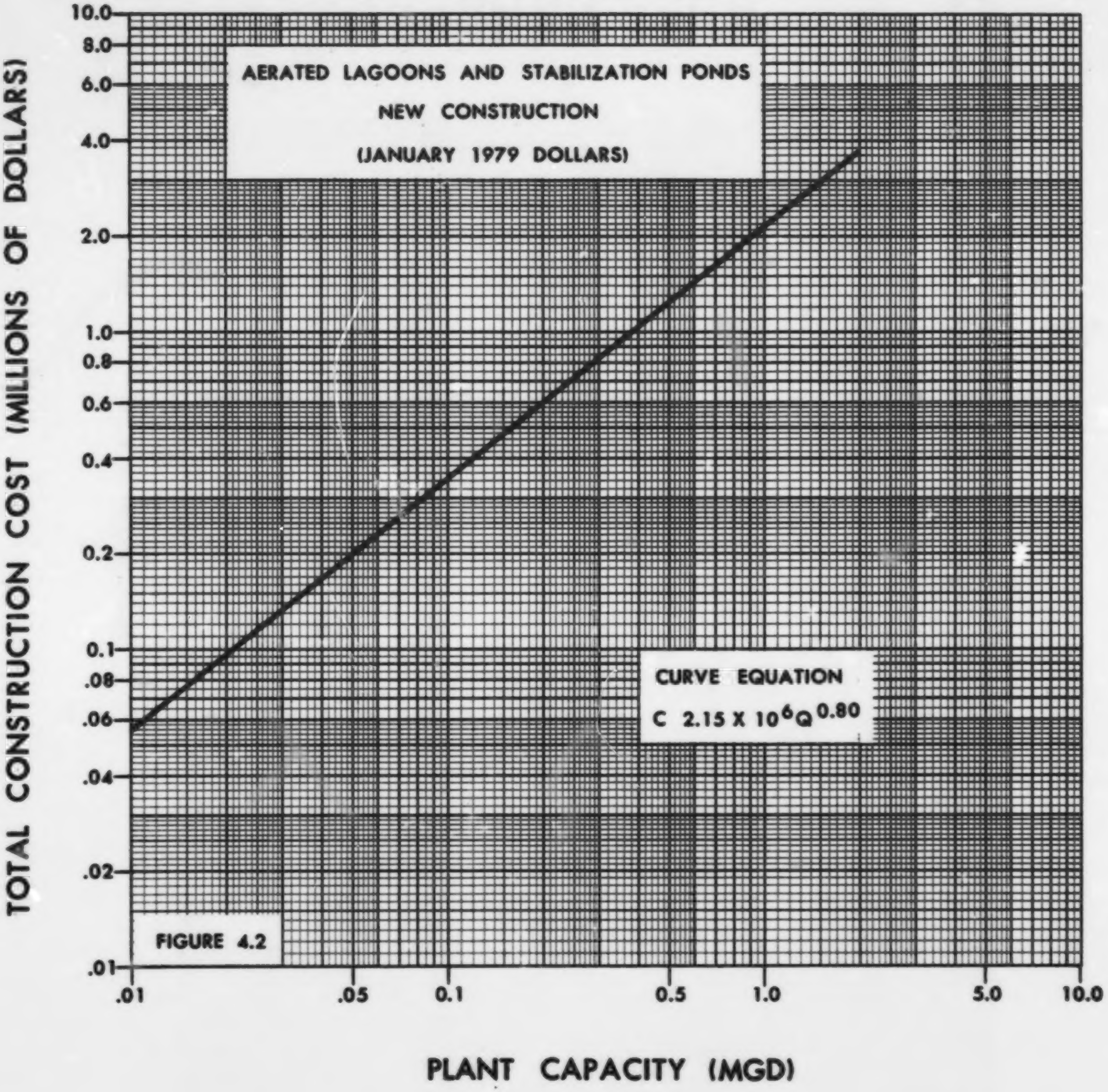


FIGURE 4.2

AERATED LAGOONS AND STABILIZATION PONDS
NEW CONSTRUCTION
(JANUARY 1979 DOLLARS)
CURVE EQUATION
C 2.15 X 10^6Q$^{0.80}$
TOTAL CONSTRUCTION COST (MILLIONS OF DOLLARS)
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
.08
.06
.04
.02
.01
.01
.05
0.1
0.5
1.0
5.0
10.0
PLANT CAPACITY (MGD)

TABLE 4.1

AREA MULTIPLIERS
WASTEWATER TREATMENT PLANT CONSTRUCTION

1	Albany, NY	1.17
2	Albuquerque, NM	0.85
3	Appleton, WI	1.04
4	Atlanta, GA	0.83
5	Baltimore, MD	1.03
6	Binghamton, NY	1.10
7	Birmingham, AL	0.75
8	Boston, MA	1.22
9	Buffalo, NY	1.14
10	Chicago, IL	1.31
11	Charlotte, NC	0.77
12	Cincinnati, OH	1.12
13	Cleveland, OH	1.15
14	Columbia, MO	0.71
15	Dallas, TX	0.79
16	Davenport, IA	0.83
17	Denver, CO	0.93
18	Des Moines, IA	0.84
19	Detroit, MI	1.12
20	Duluth, MN	1.34
21	Evansville, IN	0.95
22	Grand Rapids, MI	0.96
23	Harrisburg, PA	1.19
24	Houston, TX	0.87
25	Huntington, WV	0.84
26	Indianapolis, IN	1.23
27	Kansas City, MO	1.00
28	Lafayette, LA	0.67
29	Lafayette, IN	1.20
30	Lake Charles, LA	0.89
31	Lansing, MI	1.06
32	Los Angeles, CA	1.06
33	Louisville, KY	0.77
34	Lynchburg, VA	0.89
35	Miami, FL	0.88
36	Milwaukee, WI	1.04
37	Minneapolis, MN	1.12
38	Mobile, AL	0.78
39	New Orleans, LA	0.93
40	New York, NY	1.35
41	Philadelphia, PA	1.18
42	Pittsburgh, PA	1.04
43	Portland, ME	1.21
44	Portland, OR	0.95
45	Providence, RI	1.21
46	Rochester, NY	1.12
47	St. Louis, MO	1.07
48	San Diego, CA	0.98
49	San Francisco, CA	1.32
50	Seattle, WA	1.05
51	Springfield, MA	1.19
52	Springfield, MO	0.76
53	Syracuse, NY	1.13
54	Wheeling, WV	1.04
55	Wilkes-Barre, PA	0.95

STATE AND TERRITORIAL MULTIPLIERS

Alaska	2.74
Guam	1.40
Hawaii	1.71
Puerto Rico	0.98
Trust Territories	1.40

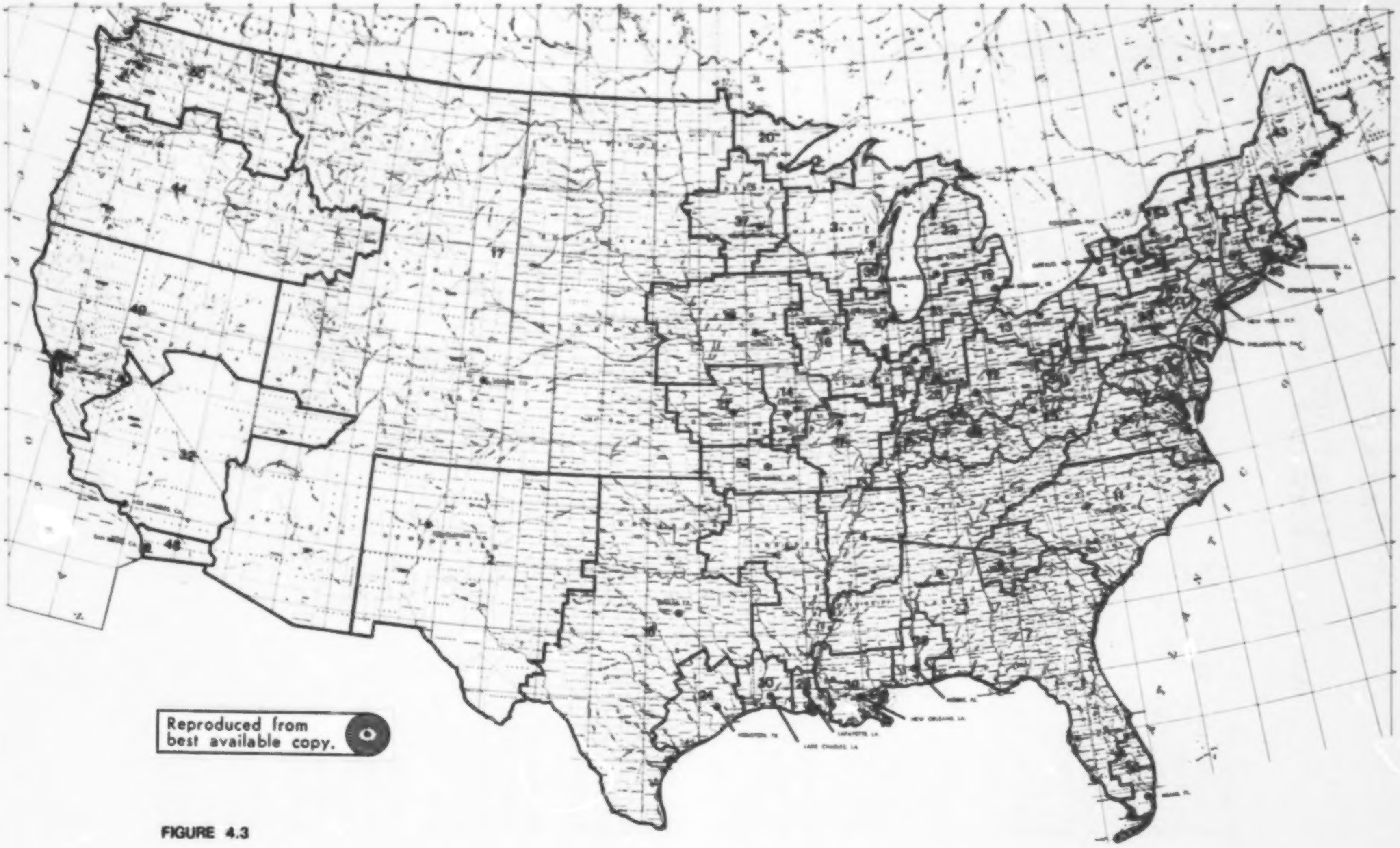

HOUSTON TX
LAKE CHARLES LA
LAFAYETTE LA
NEW ORLEANS LA
20
17
44
40
32
48
24
30

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FIGURE 4.3

E.P.A. MUNICIPAL CONSTRUCTION COST INDEX MAP

WASTEWATER TREATMENT PLANTS-AREA MULTIPLIERS

1980 NEEDS SURVEY

APPENDIX A

COST UPDATING AND NORMALIZATION TECHNIQUES

The data base used in this report includes costs from construction projects in many geographical areas of the U.S. They range in time from 1973 through 1978. In order to achieve a meaningful analysis of the data, it was necessary to index all dollar values to a specific time and location.

To accomplish this, the EPA Large City Advanced Treatment (LCAT) and Small City Conventional Treatment (SCCT) Indexes were used. These indexes have been calculated quarterly by EPA since the third quarter of 1973 for a total of 50 U.S. cities. The LCAT Index is based on a hypothetical 50.0 mgd advanced wastewater treatment facility with a base city of Kansas City, Missouri. The SCCT Index is based on a hypothetical 5.0 mgd activated sludge secondary treatment facility with a base city of St. Joseph, Missouri. The base value for both the indexes is 100 for third quarter 1973.

AREAS OF INFLUENCE

EPA publishes the LCAT and SCCT Indexes as indicators of cost trends over time and for comparative purposes by relating one city to another. The areas of cost influence for each of the 50 indexed cities are not defined. Therefore, prior to using the indexes, the area of influence for each of the index cities was assessed and mapped. Two sources of information were employed in this effort: Bureau of Labor Statistics (BLS) labor rate history for 102 U.S. cities and the Bureau of Economic Analysis (BEA) map of U.S. economic areas.

The BLS data consists of union labor rates for various skills, recorded quarterly for 102 U.S. cities. In order to apply this information, a weighted average of four construction crafts - carpenter, electrician, laborer, and plumber - were calculated for 22 calendar quarters from third quarter 1973 to the fourth quarter 1978. Data from each city were then statistically correlated with the 101 other BLS cities. Since the EPA SCCT and LCAT Index cities were included in the list of BLS cities, this process defined the area of economic influence for each of the EPA index cities.

The BEA map of economic areas was used to set the exact boundaries of economic influence surrounding the EPA index cities. A BEA economic area is composed of a central city and the surrounding counties that are economically related to the central city as determined by BEA. Each of these areas includes both the place of work and place of residence of the labor force. The resulting maps for the LCAT and SCCT Index city areas of influence are presented in Figures A.1 and A.2.

LCAT - SCCT CLASSIFICATION

In order to utilize the above maps, all projects in the data base were classified as either LCAT or SCCT Index related. The following criteria were used for that classification:

1. A mechanical treatment plant project with a projected design flow less than 15.0 mgd was related to the SCCT Index.
2. A treatment plant project with a projected design flow of 15.0 mgd or greater was related to the LCAT Index.
3. A lagoon project was related to the SCCT Index.

COST UPDATING

After a project was related to either the LCAT or SCCT Index, Figure A.1 or A.2 was utilized to relate the project to a specific LCAT or SCCT Index city. Using the indexes contained in Tables A.1 and A.2, the costs were then normalized to fourth quarter 1978 at Kansas City/St. Joseph, Missouri according to the following procedure:

$$\text{Cost of Construction at (Place x)(Time t)} \times \frac{\begin{array}{c}\text{Kansas City/St. Joseph, MO}\\ \text{4th Quarter 1978 Index}\end{array}}{\text{(Place x, Time t) Index}} =$$

Cost of Construction at Kansas City/St. Joseph, MO 4th Quarter 1978

Thus, the data base was normalized to the base cities for the indexes. The effects on the results of the analyses of a large or small quantity of data from different areas of the U.S., or from a particular time period, were thus minimized. Cost relationships resulting from an analysis of the data are indeed national averages in this report.

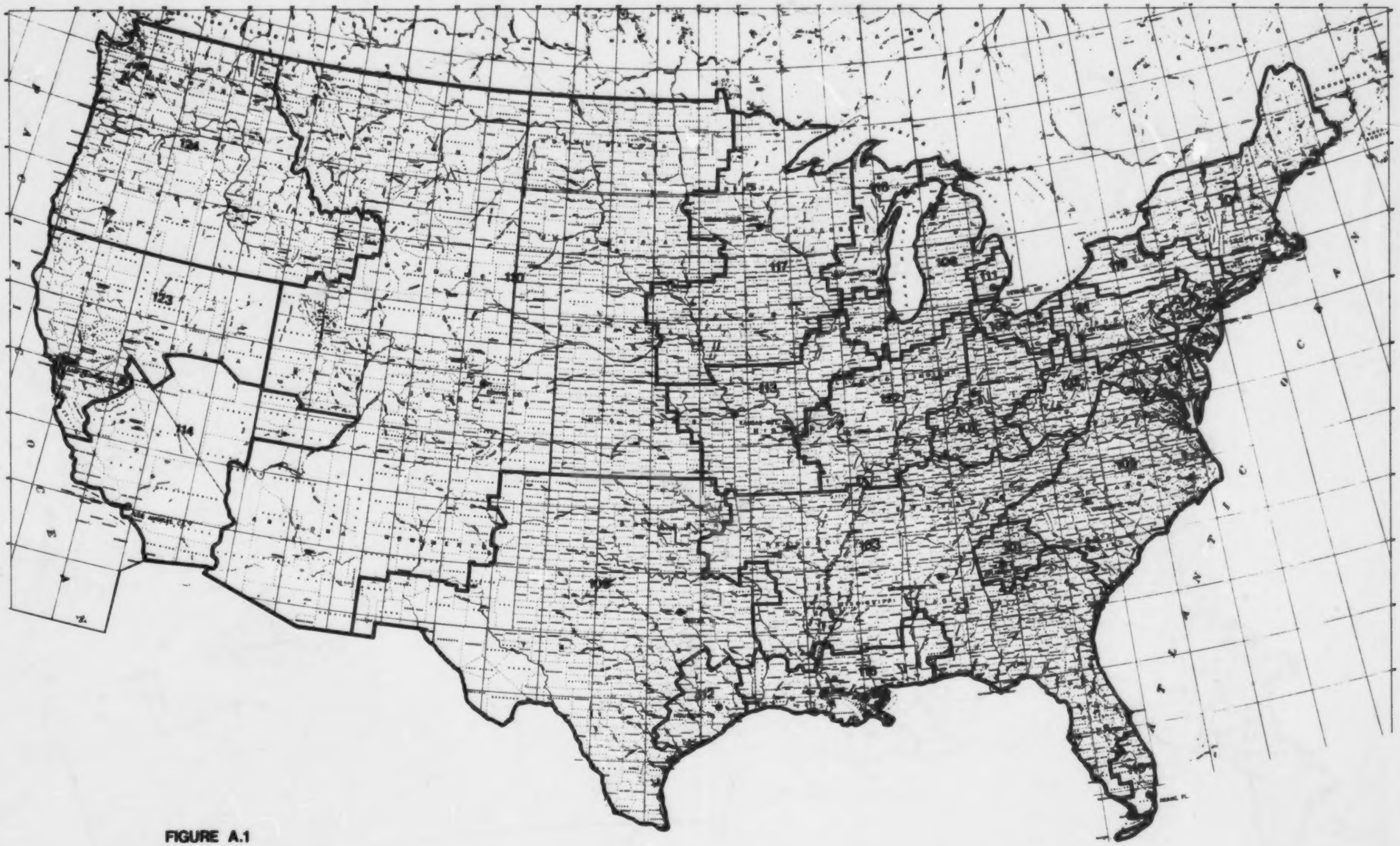
124
123
114
117
113
106
111
103

FIGURE A.1

E.P.A. MUNICIPAL CONSTRUCTION COST INDEX MAP

FOR LARGE CITY ADVANCED TREATMENT (LCAT) PLANT INDICES

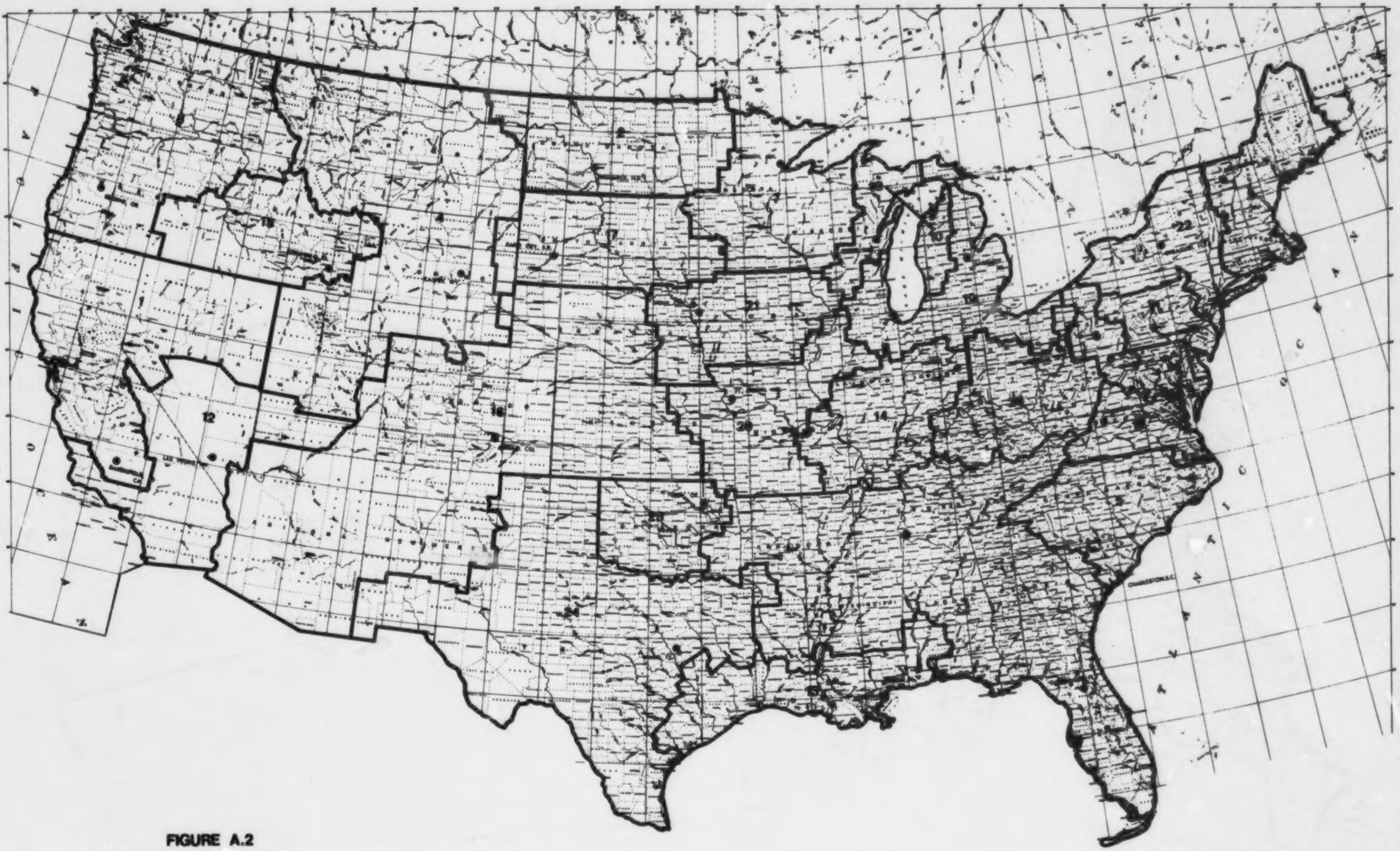
PACIFIC OCEAN
ATLANTIC OCEAN
12
16
17
21
20
14
19
10
22

FIGURE A.2

E.P.A. MUNICIPAL CONSTRUCTION COST INDEX MAP

FOR SMALL CITY CONVENTIONAL TREATMENT (SCCT) PLANT INDICES

TABLE A.1

EPA LARGE CITY ADVANCED TREATMENT (LCAT) INDEXES

	City	1973		1974				1975				1976				1977				1978			
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Atlanta	87	87	91	97	105	107	103	98	99	100	102	103	106	106	109	110	113	114	119	120	123	128
2	Baltimore	106	106	110	114	122	124	120	120	120	122	125	132	134	134	134	134	136	138	141	143	147	153
3	Birmingham	84	83	89	94	101	102	99	95	98	99	101	101	102	103	105	107	111	112	117	118	125	129
4	Boston	118	118	121	129	136	139	135	135	135	136	140	141	143	145	146	149	154	157	159	160	163	173
5	Charlotte	57	58	62	68	75	76	73	68	74	75	76	77	79	82	83	83	85	92	93	96	101	107
6	Chicago	121	121	126	135	143	144	141	137	138	140	144	146	152	153	155	158	160	162	168	169	173	180
7	Cincinnati	105	105	108	119	127	126	123	121	123	124	126	127	130	131	132	134	141	143	147	150	154	162
8	Cleveland	113	113	116	127	134	132	129	126	128	129	132	133	139	140	141	147	150	152	154	159	165	171
9	Dallas	82	83	87	96	103	102	98	93	94	95	99	104	105	107	108	111	113	116	119	120	123	130
10	Denver	87	88	91	99	107	108	105	101	105	105	108	111	113	114	115	120	122	123	125	126	131	139
11	Detroit	109	111	111	124	132	127	125	120	120	121	130	130	132	133	140	145	150	152	153	155	158	169
12	Houston	83	84	89	95	102	107	103	103	103	104	106	112	113	114	114	119	123	123	127	130	136	141
13	Kansas City	100	100	104	115	124	125	120	118	119	120	122	126	128	129	129	133	137	137	140	145	150	157
14	Los Angeles	104	103	107	113	121	127	125	121	126	126	130	133	137	138	141	141	149	150	156	156	168	173
15	Miami	92	93	96	103	110	111	108	104	105	106	108	109	110	111	112	113	119	119	122	124	127	131
16	Milwaukee	102	102	106	112	120	125	123	123	123	125	126	129	131	133	134	138	139	141	143	143	149	161
17	Minneapolis	96	96	99	107	113	115	112	108	108	109	116	120	122	123	123	127	130	131	135	138	142	149
18	New Orleans	94	92	96	102	112	118	113	110	110	113	116	120	121	123	124	128	128	129	135	138	143	150
19	New York	139	138	141	148	154	161	157	152	158	160	164	163	168	169	171	175	179	181	182	185	191	199
20	Philadelphia	122	122	125	141	148	144	140	140	141	142	146	152	154	155	155	159	163	165	167	176	170	179
21	Pittsburgh	108	108	111	123	131	130	138	125	124	126	127	129	130	131	135	138	146	147	150	154	158	162
22	St. Louis	117	117	123	130	143	140	136	136	138	139	141	147	149	150	151	153	159	161	165	169	172	182
23	San Francisco	111	110	114	121	128	134	130	128	133	134	138	141	151	152	153	153	159	163	167	170	174	182
24	Seattle	100	101	105	114	123	124	121	120	123	124	128	133	135	137	138	139	149	151	154	160	165	175
25	Trenton	115	114	117	125	134	135	130	127	129	130	133	136	140	141	140	144	147	148	152	153	158	166
NATIONAL AVERAGE		102	102	106	114	122	123	120	112	119	120	123	126	129	130	132	134	128	140	144	146	151	158

TABLE A.2

EPA SMALL CITY CONVENTIONAL TREATMENT (SCCT) INDEXES

	City	1973		1974				1975				1976				1977				1978			
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Bakersfield	105	101	103	115	122	123	121	118	119	119	127	128	132	134	138	138	144	142	148	153	162	170
2	Bismarck	81	80	84	92	97	99	96	94	98	100	102	104	107	108	108	108	112	115	120	122	127	132
3	Burlington, VT	92	92	94	101	106	108	104	101	101	102	104	104	105	107	108	108	114	116	120	120	125	133
4	Casper	84	85	88	97	104	105	102	101	101	105	108	108	114	115	115	117	118	112	128	129	133	140
5	Charlestown, SC	58	58	61	66	72	76	72	69	77	77	74	77	77	81	82	83	84	87	88	92	94	99
6	Cumberland, MD	110	109	112	120	127	128	126	126	126	128	129	130	134	135	138	143	145	146	150	150	154	161
7	Duluth	95	94	96	106	112	113	109	107	109	109	114	116	118	119	124	128	130	131	134	134	136	146
8	Eugene	102	104	107	116	123	124	121	118	119	122	130	137	137	139	141	141	143	145	151	156	160	169
9	Gainesville	80	80	83	91	97	102	99	98	97	98	100	101	101	102	104	107	109	109	113	116	119	126
10	Green Bay	103	103	107	113	119	122	123	119	119	121	123	122	124	125	131	131	132	133	139	142	148	154
11	Harrisburg	102	105	109	113	120	122	119	122	126	129	132	135	138	139	138	144	146	147	150	151	155	159
12	Las Vegas	102	101	103	113	119	124	121	119	126	127	129	130	136	140	142	142	149	153	155	158	169	174
13	Mobile	92	91	92	103	111	123	121	117	118	120	118	119	120	121	127	127	133	134	139	141	145	149
14	Muncie	95	96	98	108	114	114	112	111	112	113	114	117	120	124	123	127	130	132	136	138	141	147
15	Pocatello, ID	84	88	90	97	104	105	103	104	105	108	108	110	112	114	115	116	119	120	124	127	133	141
16	Pueblo	87	87	89	97	104	104	105	98	98	99	107	110	113	114	115	119	120	122	124	124	129	136
17	Rapid City	79	79	81	89	97	98	94	92	94	95	99	102	103	105	105	106	108	110	114	117	124	130
18	Roanoke	87	80	83	90	97	108	106	103	102	105	110	114	115	116	116	117	118	120	122	124	127	134
19	Saginaw	105	104	104	111	118	120	118	115	117	118	120	120	122	123	127	128	135	136	138	139	143	149
20	St. Joseph	100	102	106	116	122	119	115	113	113	113	116	117	120	120	124	125	126	129	134	138	145	152
21	Sioux City	90	90	95	103	108	108	105	107	107	107	113	117	118	120	120	130	133	134	136	137	140	146
22	Syracuse	124	126	127	136	141	140	137	137	138	139	142	143	146	148	147	150	155	156	159	160	165	174
23	Tulsa	81	82	85	97	102	101	99	96	97	98	101	103	104	108	109	111	114	116	120	124	128	132
24	Waco	74	73	77	84	90	92	89	87	87	88	90	91	91	92	97	99	101	101	108	112	117	122
25	Wheeling	105	106	108	116	122	122	120	118	121	122	122	124	125	126	129	132	139	128	142	143	154	158
	NATIONAL AVERAGE	93	93	95	104	110	112	109	108	109	110	113	115	119	119	121	123	126	128	132	134	139	145

APPENDIX B

DESCRIPTION OF THE DATA BASE

Data included in this study were collected from 737 Federally funded wastewater treatment plant projects in all ten EPA Regions. Forty-nine of the fifty states are represented in the data base - the exception being the State of Kentucky.

Table B.1 lists the grant number, facility name, State, projected design flow, treatment level, and change for each of the projects included. The treatment levels are defined as follows:

	Code	Level of Treatment
First Digit	2	Advanced Primary Treatment
	3	Secondary Treatment
	4	Advanced Secondary Treatment
	5	Advanced Wastewater Treatment
Second Digit	0	No Nutrient Removal Processes
	1	Ammonia Conversion or Removal
	2	Total Nitrogen Removal
	3	Phosphorus Removal
	4	Both 01 and 03
	5	Both 02 and 03

The change code refers to the type of change made to the treatment facility. The codes are defined as follows:

Code	Type of Change
01	Enlargement of treatment capacity
02	Upgrading level of treatment
03	Enlargement and upgrading
04	New construction
05	Replacement
08	Other modifications
09	Special situation

TABLE B.1

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
010250	MONROEVILLE-DOUBLE BRANCH	AL	1.00	40	04
010254	RUSSELLVILLE STP	AL	1.13	40	04
010256	NEW HOPE	AL	0.25	30	04
010289	WALNUT CREEK WWTP	AL	3.00	40	04
010296	TOWN CREEK SEWER SYSTEM	AL	0.15	30	04
010313	GROVE HILL STP	AL	0.30	30	04
020039	FAIRBANKS WWTP	AK	8.00	30	04
020043	HAINES STP & COLL	AK	0.30	30	04
020046	SKAGWAY STP & COLLECTION	AK	0.30	30	04
020047	PETERSBURG WWTP	AK	0.80	30	04
020074	KODIAK SYSTEM	AK	2.13	30	04
040125	SUPERIOR WWTP	AZ	0.75	40	04
040134	RANDOLPH PARK STP	AZ	1.50	30	04
040138	IRON SPRINGS WWTF #B	AZ	0.10	30	04
040138	IRON SPRINGS WWTF #A	AZ	0.03	30	04
040140	LAKE HAVASU STP	AZ	0.20	30	04
040141	CASA GRANDE STP	AZ	3.00	30	03
040150	CLARKDALE	AZ	0.25	30	03
040151	INA ROAD STP	AZ	25.00	30	04
040176	WINSLOW	AZ	1.55	30	05
040183	JOSEPH CITY STP	AZ	0.33	30	04
040189	WINKELMAN STP	AZ	0.12	40	01
040214	SOMERTON STP	AZ	0.80	30	03
040220	COLORADO CITY/HILDALE STP	AZ	0.30	40	04
040222	YUMA WWTP	AZ	12.10	30	01
050305	HOT SPRINGS REGIONAL WWTP	AR	12.00	50	04
050332	BATESVILLE STP	AR	4.50	40	03
050339	SPRINGDALE WWTP	AR	16.00	30	01
050346	PARAGOULD WWTP	AR	2.20	30	01
050347	PATE CREEK STP	AR	0.80	40	04
050347	BOIS D'ARC STP	AR	1.20	40	04
050350	GREENBRIER WWTP	AR	0.12	50	04
050367	WEST SIDE WWTRT WORKS	AR	3.00	40	03
050369	CONWAY STP	AR	6.00	40	04
050395	BULL SHOALS STP	AR	0.57	40	04
050397	HATFIELD STP	AR	0.07	20	04
050399	HUNTINGTON STP	AR	0.11	30	04
060669	TERMINAL ISLAND STP	CA	30.00	30	03
060696	CENTRAL CONTRA COSTA STP	CA	30.00	54	03
060731	AVALON STP	CA	1.00	30	04
060763	KERMAN WWTP	CA	0.41	30	03
060767	MAIN WQCF	CA	67.00	53	03
060771	PALM DESERT WRP	CA	2.10	30	01
060772	SCOTTS VALLEY STP	CA	0.40	30	01
060775	VISALIA WCP	CA	8.30	30	01
060778	ANGELS CAMP STP	CA	0.32	30	03
060779	ORANGE CO. WWRP #1	CA	46.00	30	01
060786	BOLINAS STP	CA	0.07	30	03
060787	LIVERMORE	CA	6.00	50	01
060790	LAGUNA WWTP	CA	15.00	30	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
060796	ROSEVILLE WWTF	CA	5.75	40	03
060797	SANTA BARBARA STP	CA	11.00	30	03
060800	BASS LAKE STP	CA	0.50	30	04
060801	CALEXICO STP	CA	2.20	30	01
060804	CENTRAL CONTRA COSTA STP	CA	30.00	50	02
060810	FAIRFIELD-SUISUN WWTF	CA	10.35	50	04
060813	INYO CA WWTF	CA	0.85	30	04
060816	NORTHWEST CLEAR LAKE REG.	CA	2.45	30	04
060818	LOMPOC REGIONAL WWTF	CA	5.00	40	03
060823	MT. SHASTA WPCF	CA	0.70	30	04
060833	SOLVANG STP	CA	0.54	30	03
060835	TULARE TREATMENT PLANT	CA	4.50	30	01
060837	VALLEJO STP	CA	13.00	30	03
060840	SOUTH WWTF	CA	7.00	30	03
060880	HOLLISTER STP	CA	1.73	41	05
060882	IMPERIAL STP	CA	0.70	30	03
060897	TERMINAL ISLAND	CA	30.00	30	08
060913	MODESTO STP	CA	45.00	30	02
060915	NAPA VALLEY-AMERICAN CANY	CA	15.00	50	03
060925	PACIFICA WPCF	CA	4.30	30	02
060938	SACRAMENTO REGIONAL WWTF	CA	136.00	43	03
060947	SAN JOSE/SANTA CLARA WPCF	CA	143.00	51	02
060950	SAN MATEO SUBREGIONAL STP	CA	13.60	50	03
060956	SHASTA DAM AREA STP	CA	0.50	30	04
060964	TRACY WWTF	CA	5.50	30	02
060967	SONORA STP	CA	2.60	30	03
060991	BLYTHE STP	CA	1.50	30	04
061023	HANFORD STP	CA	3.00	30	03
061048	JOINT WPCP	CA	100.00	30	02
061063	MODESTO STP	CA	25.00	30	02
061076	PALO ALTO STP	CA	30.60	51	02
061121	TAHOE-TRUCKEE STP	CA	4.83	53	04
061218	SIMI VALLEY STP	CA	9.10	50	02
061220	HILL CANYON STP	CA	10.00	50	02
061275	KETTLEMAN CITY STP	CA	0.12	30	04
061355	HILTON CREEK STP	CA	0.08	40	04
080322	UPPER THOMPSON WWTP	CO	1.50	33	04
080329	LITTLETON-ENGLEWOOD WWTP	CO	20.00	30	04
080330	W. JEFFERSON COUNTY WWTP	CO	0.50	30	01
080333	FRISCO STP	CO	0.50	53	02
080334	SILVERTHORNE DILLON STP	CO	2.00	53	03
080336	GLENWOOD STP	CO	2.30	30	03
080338	LOVELAND STP	CO	7.70	40	03
080344	ASPEN STP	CO	3.00	51	03
080349	SNOWMASS STP	CO	1.60	51	03
080352	LONGMONT WWTP & SEWER SYS	CO	8.20	31	03
080354	EATON WWTP	CO	0.34	30	01
080357	LYONS WWTP	CO	0.29	30	03
080401	WESTMINSTER STP	CO	2.40	30	01
090153	KILLINGLY WWTP	CT	8.00	30	04

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	REATMENT LEVEL	CHANGE
090155	STONINGTON WPCF	CT	0.66	30	04
090155	PAWCATUCK WPCF	CT	1.31	30	04
090175	NEW LONDON WPCF	CT	10.00	30	03
100061	DELAWARE CITY WWTP	DE	0.50	50	02
100088	S. COASTAL REGIONAL STP	DE	3.00	40	04
120429	PENSACOLA WTW	FL	20.00	54	03
120433	SOUTH CROSS BAYOU WTW	FL	27.00	30	01
120474	FORT LAUDERDALE STP	FL	22.00	40	03
120523	NW STP & EFFLUENT DISPOSA	FL	16.00	50	03
120574	BROWARD COUNTY STP NO. 2	FL	60.00	40	01
130315	RICHMOND HILL SEWERAGE SY	GA	0.50	30	04
130341	ROCKMART STP	GA	1.20	30	03
130357	ALMA	GA	0.75	30	04
130383	VIDALIA NORTHEAST STP	GA	1.90	51	03
130385	GUM CREEK WWTF	GA	5.00	41	03
130395	DALLAS STP	GA	0.25	40	04
130399	GWINNETT COUNTY STP	GA	3.60	54	04
130403	FAYETTEVILLE STP	GA	1.25	51	04
130404	ADEL WWTP	GA	1.30	41	03
130425	WITHLACOOCHEE WWTP	GA	4.00	41	04
130425	MUD CREEK WWTP	GA	2.20	50	04
130430	SOUTH COBB STP	GA	24.00	44	03
130489	FLAT CREEK STP	GA	7.00	33	02
130496	SHELLMAN STP	GA	0.15	30	04
150050	HANAPEPE-ELEELE WWTF	HA	0.40	30	04
150054	LAHAINA STP	HA	3.20	30	04
150057	KULAIMANO STP	HA	0.50	30	04
160144	PARIS SEWERAGE	ID	0.10	60	04
160171	PAYETTE STP	ID	2.40	30	03
160183	MERIDIAN STP	ID	2.20	41	04
160185	SOUTH FORK COEUR D'ALENE	ID	0.13	30	04
160189	POCATELLO STP	ID	7.50	30	03
160194	WEST BOISE (GARDEN CITY)	ID	5.00	30	04
160204	CULDESAC WWTP	ID	0.05	30	04
160208	GOWEN FIELD WWTP	ID	0.26	30	04
160209	HAGERMAN STP	ID	0.08	30	04
170508	BUSHNELL STP	IL	0.70	50	03
170561	RIDGEWAY	IL	0.14	50	03
170660	RICHMOND	IL	0.38	33	03
170690	SPARTA	IL	0.65	50	03
170749	TAYLORVILLE SANITARY DIST	IL	1.92	50	03
170766	MT CARMEL WWTP	IL	2.00	40	02
170865	MOMENCE	IL	1.60	40	03
170875	ALGONQUIN	IL	1.25	33	02
170924	SALEM	IL	1.00	40	03
170930	OLMSTED	IL	0.07	30	03
170956	STOCKTON	IL	0.30	40	03
170970	O'FALLON	IL	3.00	30	03
170973	DOWNERS GROVE SANITARY D.	IL	9.60	50	03
170979	LENA	IL	0.30	30	01

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
170983	BREESE STP	IL	0.63	50	04
170992	GRAYVILLE	IL	0.30	30	03
171001	GALVA	IL	0.42	50	03
171001	GALVA	IL	0.41	50	03
171006	BLOOMINGTON-NORMAL STP	IL	16.00	51	03
171023	BELLEVILLE STP NO. 2	IL	0.45	50	02
171061	COWDEN	IL	0.08	30	03
171105	BARTLETT	IL	1.54	50	04
171118	MOLINE	IL	5.50	40	03
171156	MINONK STP	IL	0.34	50	02
171172	ELGIN	IL	17.00	53	03
171182	ALTON	IL	10.50	30	03
171202	MATOON	IL	4.50	50	03
171215	GRANITE CITY STP	IL	23.00	30	03
171218	BENSENVILLE	IL	4.00	40	03
171226	STILLMAN VALLEY STP	IL	0.20	30	03
171279	CENTRALIA	IL	3.00	50	03
171294	WOODRIDGE WWTP	IL	4.00	50	03
171310	MT VERNON STP	IL	3.80	53	03
171332	EAST MOLINE	IL	11.10	40	03
171335	SYCAMORE STP	IL	3.50	50	03
171341	FULTON	IL	0.47	30	03
171365	ARTHUR	IL	0.50	50	03
171397	HINSDALE SD STP	IL	12.00	51	03
171399	SALT CREEK SANITARY DIST.	IL	5.00	51	03
171412	CARPENTERSVILLE WWTP	IL	5.00	53	03
171420	BLOOM TOWNSHIP STP	IL	12.10	51	02
171462	VILLAGE OF BARRINGTON STP	IL	3.68	54	03
171584	LIBERTYVILLE WWTP	IL	4.00	50	03
171639	LAKE CO DPW-GRANDWOOD PK	IL	0.50	50	03
171840	WHEATON SD STP	IL	8.90	51	03
175111	OHARE WATER RECLAM PLANT	IL	72.00	50	09
180260	NORTH WEBSTER	IN	0.28	53	04
180295	LOGANSPORT	IN	9.00	30	09
180295	LOGANSPORT	IN	9.00	30	09
180329	LINDEN WWTP	IN	0.10	50	04
180335	ELNORA STP	IN	0.10	50	04
180346	BIRDSEYE STP	IN	0.08	30	04
180350	HAMLET STP	IN	0.10	50	04
180354	WILLIAMSPORT STP	IN	0.22	30	04
180375	ROME CITY LAGOONS	IN	0.45	53	04
180400	BROOKLYN WWTP	IN	0.24	30	04
180410	GREENSBURG	IN	1.60	50	03
180434	CLARKS HILL WWTP	IN	0.15	50	04
180445	CARMEL WWTP	IN	3.00	43	01
180467	SEYMOUR WWTP	IN	4.30	33	03
180470	PARAGON STP	IN	0.07	50	04
180473	LAUREL	IN	0.15	30	04
180484	CLAY CITY	IN	0.12	50	04
180488	RISING SUN WWTP	IN	0.36	30	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
180494	COVINGTON WWTP	IN	0.35	30	04
180495	DUGGER	IN	0.13	50	04
180499	SALEM	IN	0.90	50	03
180502	SUNMAN	IN	0.18	50	04
180509	HYMERA STP	IN	0.25	50	04
180515	BROOKVILLE	IN	0.60	30	03
180518	TIPTON STP	IN	2.00	53	03
180520	NEW PROVIDENCE WWTP	IN	0.14	40	04
180526	STAUNTON STP	IN	0.09	53	04
180528	MARTINSVILLE WWTP	IN	2.20	30	03
180532	MUNCIE WWTP	IN	24.00	43	03
180533	PRINCETON WWTP	IN	2.00	50	03
180534	WESTVILLE WWTP	IN	0.35	50	03
180555	PENNVILLE STP	IN	0.16	50	04
180574	BOSWELL	IN	0.13	50	04
180576	DEMOTTE	IN	0.40	50	04
180591	CONVERSE WWTP	IN	0.25	33	04
180595	FREMONT STP	IN	0.30	53	03
180614	FRANKFORT STP	IN	4.68	50	03
180627	CROWN POINT WWTP	IN	3.60	53	03
180760	COLUMBUS	IN	12.40	44	03
180840	GARY STP	IN	60.00	54	02
190568	WEST LIBERTY STP	IA	1.37	30	03
190579	MASON CITY WWTP	IA	6.50	51	03
190584	SIOUX CITY WWTP	IA	30.00	30	03
190587	JEFFERSON STP	IA	1.10	30	04
190592	MUSCATINE WWTP	IA	13.00	30	03
190594	KEOKUK WWTP	IA	5.00	30	02
190598	SAC STP	IA	0.70	31	04
190603	WEBSTER STP	IA	2.90	41	03
190605	HARLAN WWTP	IA	0.72	51	04
190608	EAGLE GROVE STP	IA	0.60	31	03
190617	WOOLSTOCK SEWERS & LAGOON	IA	0.04	30	04
190637	SPENCER WWTP	IA	3.70	51	04
190645	SHELDON STP	IA	0.87	41	03
190664	IDA GROVE STP	IA	0.39	40	04
190672	WALFORD LAGOON	IA	0.04	30	04
190763	JANESVILLE LAGOON	IA	0.17	30	04
190800	WAVERLY STP	IA	1.24	30	04
190882	WASHTA LAGOON	IA	0.04	30	03
190890	CASCADE STP	IA	0.25	30	03
200365	LEAVENWORTH WWTP	KS	6.88	30	03
200429	ATLANTA LAGOONS	KS	0.21	30	04
200467	LAKIN LAGOON	KS	0.30	30	04
200478	JUNCTION CITY WWTP	KS	3.60	30	03
200505	BALDWIN STP	KS	0.43	30	03
200510	TOOLEY CREEK MDS#1	KS	0.50	30	03
200523	VALLEY CENTER STP	KS	0.50	30	03
200527	MINNEAPOLIS LAGOON	KS	0.21	60	04
200530	WINFIELD STP	KS	2.00	30	01

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
200534	FREEDONIA STP	KS	0.75	30	04
200576	LA HARPE WWTP	KS	0.14	30	04
200646	GALVA LAGOON	KS	0.06	30	03
200648	DERBY STP	KS	1.64	30	03
200653	BLUE RAPIDS LAGOON	KS	0.16	60	04
200661	TOWANDA STP	KS	0.19	30	03
220265	CITY OF KENNER WWTP	LA	5.00	30	01
220292	JEANERETTE WWTP	LA	1.32	30	04
220295	TOWN OF BASILE WWTP	LA	0.28	30	04
220305	CITY OF RUSTON WWTP	LA	4.60	30	01
220307	GILBERT WWTP	LA	0.10	30	04
220314	VILLAGE OF ROSEPINE WWTP	LA	0.15	30	04
220321	TOWN OF LIVINGSTON WWTP	LA	0.30	30	04
220430	YOUNGSVILLE STP	LA	0.19	30	04
220561	MERRYVILLE STP	LA	0.25	30	04
230102	FORT FAIRFIELD WWTP	ME	0.88	30	04
230114	OLD ORCHARD BEACH STP	ME	1.50	30	03
230117	SOUTH PORTLAND STP	ME	5.50	30	04
230122	PORTLAND WD WPCF	ME	4.54	30	04
240152	CALVERT CO SANITARY DIST	MD	0.15	30	04
240180	FRIENDSVILLE STP	MD	0.10	30	04
240243	ACCIDENT TOWN OF	MD	0.05	30	04
240255	WILLARDS WWTF	MD	0.08	30	04
240294	BALLENGER CREEK WTW	MD	2.00	30	04
240298	SAVAGE STP	MD	5.00	30	01
240311	FREEDOM DIST PROJECT	MD	1.80	30	04
240311	FREEDOM DISTRICT STP	MD	1.80	40	04
240318	CLEAR SPRING STP	MD	0.20	50	04
240346	ABERDEEN STP	MD	4.00	45	05
240393	TYLERTOWN STP	MD	0.02	30	04
240393	EWELL RHODES POINT STP	MD	0.07	30	04
240409	COX CREEK STP	MD	15.00	30	01
240422	FREDRICK CNTY METRO STP	MD	0.23	30	04
240467	CHERRY HILL	MD	0.08	50	04
250253	UPPER BLACKSTONE WPCF	MA	56.00	30	04
250255	ROCKPORT STP	MA	0.80	30	04
250266	REGIONAL STP	MA	18.10	30	04
250270	ORANGE STP	MA	1.10	30	04
250279	PALMER STP	MA	5.60	33	04
250298	SOUTH HADLEY WWTP	MA	5.10	30	03
250300	HULL WWTP & SEWERS	MA	3.07	30	04
250318	HARDWICK WWTP	MA	0.04	30	04
262034	HARBOR SPRINGS LAGOONS	MI	0.45	30	04
262041	LANSING WWTP	MI	40.50	53	03
262053	CHATHAM WWTP	MI	0.25	60	04
262073	BRONSON WWTP	MI	0.50	33	02
262127	FLINT WWTP	MI	50.00	54	03
262142	GRAND LEDGE WWTP	MI	1.50	30	03
262148	GRATIOT CO.-FULTON DPW	MI	0.70	60	04
262301	CHESANING	MI	0.58	33	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
262314	CHEBOYGAN AREA WW MANAG	MI	2.00	33	03
262326	IRON MOUNTAIN-KINGSFORD	MI	3.00	33	03
262349	DOWAGIAC WWTP	MI	2.50	43	02
262353	EATON RAPIDS	MI	1.20	33	03
262491	MT.CLEMENS & CLINTON AREA	MI	4.50	30	03
262501	OWOSSO	MI	6.00	54	03
262503	BIG RAPIDS WWTP	MI	2.40	33	02
262516	CALEDONIA STP	MI	0.14	60	04
262535	MASON	MI	1.00	54	02
262541	IONIA WWTP	MI	2.85	33	03
262543	LUCE CO. DPW	MI	1.00	33	03
262640	GLADWIN	MI	0.65	33	02
263271	JONESVILLE STP	MI	0.32	54	02
263279	MARQUETTE CNTY	MI	6.20	33	03
270663	MSR OF TC-PRELIMINARY TMT	MN	345.00	30	09
270664	PRELIMINARY TMT FACILITIE	MN	290.00	30	09
270720	VIRGINIA	MN	2.00	53	03
270725	TWO HARBORS WWTP	MN	1.20	33	03
270741	ROGERS	MN	0.15	30	04
270747	ST CLOUD	MN	13.00	30	04
270748	WESTERN LAKE SUPERIOR SAN	MN	43.60	33	04
270816	HOYT LAKES STP	MN	0.50	33	02
270818	STOCKTON LAGOONS	MN	0.07	30	04
270821	MOUNTAIN IRON STP	MN	0.55	33	04
270837	TAUNTON WWTP	MN	0.02	30	04
270838	ZIMMERMAN LAGOONS	MN	0.08	30	04
270844	ALEXANDRIA LAKE, ETAL.	MN	2.55	33	04
270845	BREEZY POINT STP	MN	0.12	30	04
270845	BREEZY POINT LAGOONS	MN	0.12	60	04
270854	ELK RIVER STP	MN	1.04	30	01
270871	FARIBAULT WWTP	MN	3.50	30	03
270949	MARSHALL WWTP	MN	4.30	50	03
270970	MADISON LAKE	MN	0.09	50	04
276743	DOVER-EYOTA ST CHARLE STP	MN	0.80	50	04
280373	MERIDIAN STP	MS	13.00	42	03
280540	MANTACHIE STP	MS	0.12	42	04
290480	ST. JOSEPH WWTP	MO	32.85	30	03
290524	MONETT WWTP	MO	3.07	30	03
290560	WENTZVILLE STP	MO	1.10	40	04
290587	WESTSIDE STP	MO	22.50	30	02
290603	NEVADA WWTP	MO	2.11	30	04
290629	INDEPENDENCE (ROCK CREEK)	MO	7.50	30	04
290634	CHARLESTON STP	MO	0.75	30	02
290646	WYATT LAGOON & SEWERS	MO	0.06	30	04
290655	WARRENSBURG STP	MO	1.70	30	04
290658	CUBA STP	MO	0.46	30	04
290662	BEVIER LAGOON	MO	0.01	30	04
290669	QULIN STP	MO	0.10	30	04
290673	JEFFERSON STP	MO	6.20	30	02
290683	TIPTON STP	MO	0.44	30	04

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
290701	ST. JAMES STP	MO	0.46	30	04
290711	BOURBON STP	MO	0.22	30	04
290747	BUFFALO STP	MO	0.46	30	04
290751	WAYNESVILLE STP	MO	1.25	30	03
290782	CROCKER STP	MO	0.20	30	04
290794	BUSHY CREEK STP	MO	0.40	30	04
300163	KALISPELL WWTP	MT	2.70	31	02
300194	FLAXVILLE LAGOONS	MT	0.01	60	04
300197	GREAT FALLS STP	MT	21.00	30	03
300204	POPLAR WWTP	MT	0.60	30	04
310393	WAKEFIELD LAGOON	NE	0.27	30	03
310398	FREMONT WWTP	NE	10.50	30	03
310407	BLAIR WWTP	NE	2.00	30	04
310421	SPRINGFIELD WWTP	NE	0.22	30	04
310433	YORK WWTP	NE	2.30	30	03
310435	ARLINGTON WWTP	NE	0.17	30	03
310453	GRAND ISLAND STP	NE	10.00	30	01
310466	HEBRON WWTP	NE	0.25	30	03
310472	NEBRASKA CITY STP	NE	2.11	30	03
310476	VALLEY STP	NE	0.48	30	03
310493	NORTHEAST STP	NE	8.00	41	04
310497	HICKMAN STP	NE	0.17	30	04
310500	WILBER STP	NE	0.29	30	04
310547	OSHKOSH STP	NE	0.13	30	04
310550	BLUE HILL STP	NE	0.09	30	04
310567	MCCOOK STP	NE	2.03	30	03
310574	ARNOLD STP	NE	0.08	30	04
310575	THEDFORD LAGOON	NE	0.03	30	04
320076	YERINGTON STP	NV	0.54	60	03
320078	RENO-STEAD STP	NV	1.00	30	03
320085	FALLON WWTF	NV	0.64	60	03
320086	MINDEN-GARDNERVILLE STP	NV	1.50	30	01
320091	BEATTY STP	NV	0.10	60	04
320097	MCDERMITT STP	NV	0.05	60	01
320107	OVERTON STP	NV	0.18	60	04
320108	SEARCHLIGHT STP	NV	0.03	60	04
320111	WEST WQ CONTROL PLANT	NV	32.00	40	02
320120	LOVELOCK STP	NV	0.50	30	04
330093	MANCHESTER WWTP	NH	26.00	30	04
330104	ALLENSTOWN STP	NH	1.05	30	04
330111	BERLIN STP	NH	4.10	30	04
330119	WARNER VILLAGE STP	NH	0.17	30	04
330137	LISBON LAGOONS	NH	0.29	30	04
330161	DURHAM STP	NH	2.50	30	03
340299	LINDEN-ROSELLE SEWERAGE A	NJ	17.00	30	03
340333	PARSIPPANY-TROY HILL STP	NJ	16.00	30	01
340340	JOINT MFG UNION&ESSEX CO.	NJ	75.00	30	03
340344	ATLANTIC COUNTY S.A.	NJ	40.00	30	04
340350	LIVINGSTON WTW UPGRADE	NJ	3.50	30	01
340354	PEQUANNOCK.LINCOLN PARK	NJ	7.50	51	04

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
340356	OCEAN CO SEWERAGE AUTH(N)	NJ	28.00	30	04
340358	PEMBERTON M Y A	NJ	2.50	33	04
340372	OCEAN COUNTY S.A CENTRAL	NJ	24.00	30	04
340377	S MONMOUTH S.A.	NJ	8.00	30	04
340383	HAMILTON TOWNSHIP	NJ	16.00	30	03
340386	BERGEN CO SEWER AUTHORITY	NJ	75.00	30	01
340388	HANOVER SEWER AUTHORITY	NJ	3.00	30	01
340550	CUMBERLAND CO. SEWERAGE A	NJ	7.00	30	03
350171	LAS CRUCES WWTP	NM	6.00	30	01
350188	CITY OF LORDSBURG WWTP	NM	0.80	30	04
351004	HOBBS STP	NM	4.00	40	04
351015	RATON WWTP	NM	1.20	30	04
351029	CITY OF PORTALES WWTP	NM	1.14	30	04
351034	LAS VEGAS SS	NM	2.50	40	04
360384	MARION STP	NY	0.13	51	04
360389	RENSSELAER COUNTY S.D.	NY	24.00	30	04
360433	SAG HARBOR SEWAGE SYS	NY	0.10	30	04
360446	CLAYTON STP	NY	0.30	30	04
360485	ONTARIO TOWN SEWERAGE SYS	NY	1.00	54	09
360534	SACKETS HARBOR STP	NY	0.60	30	04
360567	NEW ROCHELLE S.D.	NY	13.60	30	02
360621	GREENPORT	NY	0.50	30	02
360640	WALTON STP & SEWERS	NY	1.17	40	04
360644	WATERFORD SEWERAGE SYSTEM	NY	1.50	30	04
360646	CORLESKILL WTW	NY	0.75	30	03
360650	GROTON WTW	NY	0.25	30	03
360652	ADAMS STP	NY	0.45	41	04
360659	SYRACUSE METRO	NY	80.00	33	03
360661	MASSENA STP	NY	2.50	30	02
360680	CHAUTAUQUA LAKE SO	NY	4.10	30	04
360691	ORANGE CO.S.D #1	NY	2.00	51	04
360711	GRAND ISLAND WWTP	NY	3.50	53	03
360728	CANAJOHARIE STP	NY	2.85	30	03
360732	MINETTO STP	NY	0.60	30	04
360742	LISHAKILL COLONIE	NY	5.00	30	04
360747	NIAGARA FALLS AWT	NY	48.00	33	03
360750	CHAMPLAIN PK S.D.	NY	0.16	30	03
360771	WESTFIELD SEWER IMPROVEM	NY	2.60	33	04
360783	OCEAN BEACH STP	NY	0.50	32	02
360786	WATKINS GLEN STP	NY	0.70	30	03
360812	SODUS POINT STP	NY	0.57	30	04
360824	ALBION AWT	NY	2.00	53	04
360843	STONY POINT STP	NY	8.00	30	01
360854	DEPOSIT SEWERAGE SYSTEM	NY	0.40	30	04
360859	MARATHON SEWER SYSTEM	NY	0.20	30	04
360914	SHERMAN STP	NY	0.14	50	04
360922	SOMERSET-BARKER STP	NY	0.28	30	04
370364	TARBORO WTW	NC	3.00	30	03
370377	IRWIN CREEK STP	NC	10.00	50	02
370377	MALLARD STP	NC	3.00	51	04

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
370377	MCALPINE STP	NC	30.00	51	03
370382	CONCORD WTW	NC	24.00	40	04
370383	FARMVILLE WTW	NC	3.50	51	04
370385	EAST BURLINGTON STP	NC	12.00	40	03
370386	WILSON BAY STP	NC	4.46	30	03
370417	DUNN STP	NC	2.28	40	04
370425	CLINTON STP	NC	3.00	50	02
370433	RED SPRINGS STP	NC	1.50	32	03
370441	MOORE COUNTY REG. WTW	NC	6.70	51	04
380294	ENDERLIN WTW & SS	ND	0.25	30	01
380313	SHELDON LAGOON AND CS	ND	0.03	30	04
380321	BISMARCK WWTP	ND	5.04	30	03
380324	HARVEY LAGOONS	ND	0.28	30	04
380325	MANDAN STP	ND	2.00	30	03
380326	NEW TOWN LAGOON	ND	0.20	30	03
380329	DICKINSON LAGOONS	ND	1.49	30	03
380332	CRARY WWTP	ND	0.02	30	04
380334	MINNEWAUKAN LAGOONS	ND	0.06	30	03
380335	WAHPETON STP	ND	0.83	30	03
380342	DOUGLAS LAGOON	ND	0.01	30	03
380370	PETERSBURG LAGOON	ND	0.04	30	03
380375	VERONA LAGOON	ND	0.02	30	04
380376	GRANVILLE LAGOON	ND	0.03	30	03
380377	MUNICH LAGOON	ND	0.04	30	03
380379	SOURIS LAGOON	ND	0.01	30	04
380380	STARKWEATHER LAGOON	ND	0.02	30	03
380387	NEW ENGLAND LAGOON	ND	0.12	30	03
380389	REYNOLDS LAGOON	ND	0.03	30	03
380390	RUTLAND LAGOON	ND	0.03	30	03
380394	WOODWORTH LAGOON	ND	0.01	30	04
380395	BERTHOLD LAGOON	ND	0.02	30	03
380399	LIGNITE LAGOON	ND	0.03	30	03
380453	EDMORE LAGOON	ND	0.04	30	03
380465	BEULAH LAGOON	ND	0.53	30	03
390464	VAN WERT	OH	2.75	53	03
390514	RAVENNA	OH	2.80	44	03
390556	LITTLE MIAMI WWTP	OH	38.00	30	03
390586	MINERAL CITY	OH	0.15	30	04
390589	OAK HARBOR WWTP	OH	0.74	30	03
390590	PLEASANT HILL	OH	0.20	30	03
390591	EUCLID	OH	22.00	43	03
390593	MOUNT VERNON WWTP	OH	5.00	43	03
390599	URBANA WWTP	OH	3.00	34	03
390622	CANTON	OH	33.00	51	03
390626	LIMA WWTP	OH	18.50	54	02
390627	MASSILLON	OH	12.00	43	03
390630	BURTON WWTP	OH	0.27	40	03
390644	CIRCLEVILLE	OH	3.50	33	04
390648	OREGON WWTP	OH	8.00	43	04
390654	HAMILTON	OH	24.70	33	01

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
390657	MEDINA COUNTY REGIONAL TP	OH	2.00	53	04
390663	HASKINS WWTP	OH	0.10	50	04
390680	NEW KNOXVILLE WWTP	OH	0.12	51	04
390683	FRENCH CREEK STP	OH	7.50	54	04
390684	MEAWDER WATERSHED, ETAL.	OH	4.00	43	04
390686	FAIRFIELD	OH	6.00	34	03
390702	MONTGOMERY CO WEST REG PT	OH	20.00	54	04
390717	PROSPECT	OH	0.12	30	04
390740	CLARK COUNTY STP	OH	2.00	54	04
390741	CLEVELAND RSD-SOUTHERLY	OH	200.00	33	08
390746	ERIE COUNTY STP	OH	1.20	33	03
390753	BLOOMINGBURG	OH	0.16	50	04
390754	SHERWOOD WWTP	OH	0.16	30	04
390844	MALVERN STP	OH	0.35	30	04
390902	WARSAW STP	OH	0.17	30	04
390957	SWANTON WWTP	OH	0.92	40	03
390982	SOUTH POINT WWTP	OH	1.20	30	03
390996	CANTON STP	OH	33.00	53	02
390999	LIVERPOOL WWTP	OH	10.00	53	03
391001	PREBLE COUNTY WWTP	OH	0.60	54	04
391005	ASHLEY	OH	0.19	44	04
391259	PERRYSVILLE STP	OH	0.13	30	04
400537	WEWOKA WWTP	OK	0.75	30	03
400584	BETHANY STP	OK	5.00	54	03
400618	YUKON STP	OK	3.00	30	04
400630	MCALESTER STP	OK	2.50	40	03
400638	AMRER LAGOONS	OK	0.04	30	04
400639	CHICKASHA STP	OK	3.00	40	05
400640	KINGSTON STP	OK	0.25	40	04
400644	COTTON COUNTY RWD LAGOON	OK	0.05	60	04
400648	ALTUS WWTP	OK	2.00	43	04
400662	LAVERNE STP	OK	0.22	30	04
400674	STILLWATER WWTP	OK	6.00	40	03
400682	PERRY WWTP	OK	0.75	40	04
400743	MARTHA LAGOONS	OK	0.03	60	04
400779	NO CANADIAN WWTP	OK	40.00	30	04
410320	WILLOW LAKE STP	OR	35.00	30	01
410323	NETARTS-OCEANSIDE STP	OR	0.24	40	04
410341	TRYON CREEK STP	OR	10.50	40	03
410355	CORVALLIS STP	OR	9.70	51	03
410365	DEPOE BAY STP	OR	0.80	30	04
410371	DURHAM WWTP	OR	20.00	41	04
410411	REDWOOD SANITARY DISTRICT	OR	0.50	30	04
410416	CLOVERDALE STP	OR	0.04	50	04
410417	PACIFIC CITY STP	OR	0.30	50	04
410423	CAVE JUNCTION STP	OR	0.15	40	03
410424	BOARDMAN LAGOON	OR	0.40	30	04
410427	AUMSVILLE LAGOONS	OR	0.32	50	03
410434	GLENDALE STP	OR	0.25	50	04
410436	SUTHERLIN STP	OR	1.30	50	04

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
410438	JOHN DAY STP	OR	0.60	40	01
410444	MOLALLA STP	OR	0.80	50	04
410446	LEBANON STP	OR	3.00	50	03
410475	LA GRANDE STP	OR	2.60	30	03
410485	ROCK CREEK AWTP	OR	15.00	53	04
410508	AMITY STP	OR	0.14	30	01
410510	JEFFERSON STP	OR	0.40	40	03
410528	COVE STP	OR	0.06	30	04
420572	HICKORY TWP MUNIC.AUTH.	PA	2.50	40	03
420585	LOCK HAVEN STP	PA	3.75	30	03
420600	VALLEY FORGE SEWER AUTH	PA	8.00	30	04
420622	PORTAGE JOINT SEWER AUTH	PA	1.00	30	04
420643	ELIZABETHVILLE	PA	0.28	30	02
420657	TRI-BORO MUNICIPAL AUTH	PA	0.50	30	04
420701	MOSHANNON VALLEY J.S.A.	PA	1.50	30	04
420704	OIL CITY GENERAL AUTH.	PA	4.00	30	03
420707	MC CANDLESS TWP SAN.AUTH	PA	3.00	30	04
420711	HAMILTONBAN TWP AUTH	PA	0.03	30	04
420712	OLEY TWP MUNICIPAL AUTH	PA	0.25	30	04
420715	MIDDLETOWN BOROUGH AUTH	PA	2.20	33	03
420718	SHOEMAKERSVILLE MWWTF	PA	0.35	40	03
420719	ALEXANDRIA STP	PA	0.12	30	04
420720	MONTGOMERY W & S AUTHORIT	PA	0.60	30	02
420723	ADAMS TOWNSHIP	PA	0.03	30	04
420724	UPPER STONYCREEK J.M.A.	PA	0.27	30	04
420728	MILTON MUNICIPAL AUTHORIT	PA	2.60	30	03
420733	THOMPSONTOWN MUNICIPAL A.	PA	0.11	30	04
420735	EAST NORRITON STP	PA	9.30	40	03
420737	NEW KENSINGTON M.S.A.	PA	7.00	30	02
420738	YORK CITY SEWER AUTHORITY	PA	26.00	50	03
420739	POINT MARION MUNICIPAL AU	PA	0.30	30	04
420742	TREMONT MUNICIPAL AUTH	PA	0.33	43	04
420749	CORAOPOLIS STP	PA	3.00	30	03
420760	SYKESVILLE MUNICIPAL AUTH	PA	0.20	30	04
420775	CARMICHAELS-CUMBERLAND ST	PA	0.60	30	04
420781	SCHUYLKILL HAVEN MUNIC.A	PA	2.00	33	03
420783	BROWN TWP MUNICIPAL AUTH	PA	0.25	30	04
420793	FREEDOM TWP. STP.	PA	0.20	40	04
420810	SHIPPENSBURG STP	PA	2.75	44	03
420820	MOUNTAINTOP AREA	PA	1.83	30	04
420841	GROVE CITY STP	PA	3.00	44	03
420845	MYERSTOWN STP	PA	1.40	44	03
420861	LATROBE STP	PA	5.00	51	03
420901	BOYERTOWN STP	PA	0.75	53	02
420917	PORTER-TOWER JOINT M.A.	PA	0.43	33	04
420938	ALLEGHENY TOWNSHIP STP	PA	0.10	40	04
420990	BETHEL STP	PA	4.10	40	03
420997	WEST GOSHEN STP	PA	4.50	41	03
421002	LYNN TWP STP	PA	0.08	44	04
421004	HARRISBURG SEWERAGE AUTH.	PA	30.90	33	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
421020	AMBLER STP	PA	6.50	51	03
421042	VANPORT STP	PA	1.56	30	01
421048	UNITY TWP STP	PA	0.50	41	04
421071	BUTLER AREA STP	PA	10.00	54	03
421074	CHAMBERSBURG STP	PA	5.20	51	03
421188	FRANKLIN STP	PA	0.50	51	04
421270	EXETER STP	PA	2.40	51	03
440074	BLOCK ISLAND WWTP	RI	0.28	30	04
440079	BURRILLVILLE STP	RI	1.50	33	04
440086	SMITHFIELD REGIONAL WWTF	RI	3.50	30	04
440087	JAMESTOWN STP	RI	0.73	30	04
450265	SANTEE PUBLIC SERVICE DIS	SC	0.30	40	04
450321	HORSE CREEK STP	SC	20.00	30	04
450366	OCONEE COUNTY STP	SC	5.00	33	04
460222	VIVIAN LAGOON & COLL.SYS.	SD	0.02	60	04
460231	LEAD-DEADWOOD STP	SD	2.33	31	04
460234	MITCHELL WWTP	SD	3.00	30	08
460238	RAMONA WWT PONDS	SD	0.03	60	04
460259	HENRY WWT POND	SD	0.02	60	04
460272	BROOKINGS STP	SD	2.99	51	04
460276	BLUNT LAGOON	SD	0.04	60	04
460288	PIERRE STP	SD	1.58	30	03
460293	FLANDREAU STP	SD	0.35	60	04
460310	MARION LAGOON	SD	0.10	30	03
460472	BRUCE LAGOON & COLL. SYS.	SD	0.03	60	04
470352	GATLINBURG WWTP	TN	3.00	41	04
470355	MCEWEN STP	TN	0.50	51	03
470384	CENTRAL STP	TN	95.50	50	03
470385	THIRD CREEK STP	TN	40.00	31	03
480799	BLOOMING GROVE WWTP	TX	0.10	40	03
480856	CROCKETT WWTP	TX	1.00	30	04
480878	MERTZON WWTP	TX	0.05	30	04
480938	KERRVILLE CITY WWTP	TX	2.05	30	01
480952	SULFUR SPRINGS WWTP	TX	2.50	40	03
480981	CROSBY WWTP	TX	0.25	40	04
481017	VILLAGE CREEK WWTP	TX	96.00	51	03
481021	LONGVIEW WWTP	TX	15.60	51	03
481030	GREENVILLE STP	TX	5.29	43	03
481048	BAYTOWN CITY WWTP	TX	3.00	40	01
481062	BURKBURNETT WWTP	TX	2.20	30	01
481084	CLEAR LAKE CITY WWTP	TX	4.50	43	03
481088	BEVIL OAKS STP	TX	0.20	40	04
481110	SILVER LAKE WWTP	TX	1.00	40	03
481112	WILLIS STP	TX	0.40	40	04
481123	TEXAS CITY STP	TX	7.50	53	04
481124	DALLAS SOUTHSIDE STP	TX	30.00	50	01
481169	ALVORD STP	TX	0.11	40	04
481191	LUMBERTON MUD STP	TX	1.50	40	04
481216	BROADWAY STP	TX	10.00	40	02
481244	BELL CNTY STP	TX	15.00	51	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
481271	SOMERSET STP	TX	0.18	40	04
490142	CEDAR CITY WWTP	UT	2.26	50	04
490152	HYRUM CITY WWTP & COLL.	UT	0.88	50	04
490170	GRANGER - HUNTER IMP DIST	UT	7.30	40	02
490171	WELLSVILLE STP	UT	0.20	60	04
490175	TROPIC TOWN OF	UT	0.04	30	04
490180	MYTON LAGOON	UT	0.12	60	04
490181	EMERY TOWN PONDS & COLL.	UT	0.03	60	04
490194	PROVO CITY WWTP	UT	21.00	50	03
490197	SNYDERVILLE BASIN STP	UT	2.00	50	04
490207	TIMPANOGOS STP	UT	7.60	30	04
490244	CASTLE VALLEY STP	UT	0.70	50	04
500079	BRANDON WWTP	VT	0.70	30	03
500081	HARTFORD WWTP	VT	1.00	30	04
500083	NORTH BRANCH F.D. STP	VT	0.82	30	04
500089	ENOSBORG FALLS	VT	0.26	30	04
500105	MANCHESTER STP	VT	0.60	30	04
500115	READSBORO STP	VT	0.10	30	04
500117	ROYALTON STP	VT	0.07	30	04
510259	UPPER SMITH RIVER WWTP	VA	4.00	30	04
510314	GALAX STP	VA	1.50	30	03
510331	UPPER OCCOQUAN REGIONAL	VA	22.50	54	04
510355	CLIFTON FORGE STP	VA	2.00	30	03
510356	ALEXANDRIA STP	VA	54.00	54	03
510357	ARLINGTON COUNTY	VA	30.00	33	02
510370	ROANOKE STP	VA	35.00	30	01
510375	STUART STP	VA	0.30	30	04
510383	ROUND HILL	VA	0.10	50	04
510384	WAVERLY STP	VA	0.35	30	03
510396	LEXINGTON STP	VA	2.00	30	03
510442	ROANOKE STP	VA	35.00	54	02
510485	CULPEPER STP	VA	3.00	40	04
510490	MCKENNEY STP	VA	0.10	30	04
510498	BLACKBURG-VPI SAN.AUTH	VA	6.00	30	04
510500	REEDVILLE STP	VA	0.20	30	04
510509	RIVANNA STP	VA	15.00	50	04
510515	POUND STP	VA	0.18	30	04
510517	MARTINSVILLE STP	VA	6.00	30	03
530466	BIRCH BAY(WHATCOM CO WD#8	WA	1.60	30	04
530488	WESTPORT WWTF	WA	1.00	30	03
530504	OLYMPIA STP	WA	9.10	30	03
530513	ARLINGTON STP	WA	1.00	30	03
530516	BURLINGTON STP	WA	1.20	30	04
530530	WEST LONGVIEW STP	WA	0.20	30	03
530549	STEVENS PASS-YODELIN STP	WA	0.06	50	04
530553	WHITE SWAN W&S	WA	0.10	60	04
530560	ENUMCLAW STP	WA	2.50	30	05
530568	GINKGO STP	WA	0.10	30	04
530578	VADER STP	WA	0.71	30	03
530580	SPOKANE WWTF	WA	40.00	33	03

TABLE B.1 (Continued)

WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

GRANT NO	FACILITY NAME	STATE	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
530582	WASHOUGAL STP	WA	1.60	30	03
530600	WAPATO STP	WA	1.10	30	03
530604	SHELTON STP	WA	3.34	30	04
530613	WINLOCK STP	WA	0.30	30	03
530724	RYDERWOOD STP	WA	0.09	30	04
530740	GLENWOOD STP(KLICKITAT CO	WA	0.10	30	04
530812	WISHRAN STP PUD#1	WA	0.10	30	04
530829	HOQUIAM STP	WA	2.34	30	03
540198	WEIRTON STP	WV	4.00	30	02
540208	DELBARTON	WV	0.12	30	04
540213	BLUEFIELD	WV	3.50	40	04
540336	MALDEW STP	WV	1.50	30	04
540424	ST. ALBANS STP	WV	2.50	30	02
550488	TWO RIVERS	WI	4.40	43	03
550518	LUXEMBURG STP	WI	0.35	20	04
550548	SUPERIOR STP	WI	5.00	33	02
550552	RACINE STP	WI	30.00	34	03
550573	LOMIRA WWTP	WI	0.49	40	04
550625	MONTREAL WWTP	WI	0.20	30	02
550631	OCONOMOWOC WWTP	WI	4.02	50	04
550648	MANITOWOC WWTP	WI	15.50	33	01
550649	OMRO STP	WI	0.54	33	04
550662	RHINELANDER STP	WI	1.90	30	03
550665	THREE LAKES STP	WI	0.13	40	02
550686	KEWAUNEE STP	WI	0.58	33	01
550686	KEWAUNEE WWTP	WI	0.58	33	01
550687	RIPON STP	WI	2.00	53	03
550689	HOLLAND STP	WI	0.20	44	03
550706	DEPERE WWTP	WI	14.20	33	03
550734	MADISON MSD	WI	51.30	30	01
550787	MARSHFIELD STP	WI	3.50	30	02
550790	STOUGHTON STP	WI	1.65	30	03
550794	CASCO	WI	0.07	30	02
550820	NORTHERN MORAINE UC STP	WI	0.60	30	04
560104	COWLEY STP & COLL.	WY	0.05	60	04
560109	CASPER WWTP	WY	6.40	30	03
560110	LABARGE WWTP & COLL. SYS.	WY	0.04	30	04

* U. S. GOVERNMENT PRINTING OFFICE : 1980 620-228/4078